Online Appendix

Impacts of US, Mexican, and Canadian Trade Agreement on Commodity and Labor Markets

A Model

A.1 Consumer

In each USMCA member country ($i = U, M, C$), low-skilled ($j = N$) and skilled ($j = E$) representative consumers maximize utility (equation 1 defined in the main text) by consuming goods from each of the four sectors (DY, DX_1, DX_2, DV) and leisure (DL) subject to their respective budget and time constraints. For US and Canadian low-skilled and skilled consumers and Mexican skilled consumers, the budget constraint is equation (2) and time constraint ($\overline{L}^{ij} = L_S^{ij} + DL^{ij} \quad ij = UN, UE, CN, CE, ME$). For Mexican low-skilled consumers, the budget constraint is equation (3) and time constraint. As a result, demand function for composite traded goods (DY^{ij}, DX_1^{ij}, and

DX_2^{ij}), service & construction goods (DV^{ij}), and leisure (DL^{ij}) can derived as

$$\begin{aligned}
DY^{ij} &= \frac{I^{ij}}{\left(\frac{\beta_{DY}^{ij}}{P_Y^{ij}}\right)^{\frac{1}{\rho^{ij}-1}} P^{ij}}, \\
DX_1^{ij} &= \frac{I^{ij}}{\left(\frac{\beta_{DX_1}^{ij}}{P_{X_1}^{ij}}\right)^{\frac{1}{\rho^{ij}-1}} P^{ij}}, \\
DX_2^{ij} &= \frac{I^{ij}}{\left(\frac{\beta_{DX_2}^{ij}}{P_{X_2}^{ij}}\right)^{\frac{1}{\rho^{ij}-1}} P^{ij}}, \\
DV^{ij} &= \frac{I^{ij}}{\left(\frac{\beta_{DV}^{ij}}{P_V^{ij}}\right)^{\frac{1}{\rho^{ij}-1}} P^{ij}}, \\
DL^{ij} &= \frac{I^{ij}}{\left(\frac{\beta_{DL}^{ij}}{w^{ij}}\right)^{\frac{1}{\rho^{ij}-1}} P^{ij}}.
\end{aligned}$$

where $I^{ij} = \Psi^{ij}\left(\Pi_Y^i + \Pi_{X_1}^i + \Pi_{X_2}^i + \Pi_V^i + r^i \bar{K}^i + G^i\right) + w^{ij} L_S^{ij}$ $i = U,\ M,\ C;\ ij = UN,\ UE,\ CN,\ CE,\ MN,\ ME$ and $I^{MN} = \Psi^{MN}\left(\Pi_Y^M + \Pi_{X_1}^M + \Pi_{X_2}^M + \Pi_V^M + r\overline{K}^M + G^M\right) + w^{MN} L_S^{MN} + w^I L^{UI} + w^{UG} L^{UG}$.

Given the Armington assumption for traded goods, consumers minimize expenditure on the traded goods $\sum_k P_O^{ik} DO^{ijk}$ $(O = Y, X_1, X_2,\ k = U, M, C, R)$ subject to the aggregate demand for goods of domestic production and imports equal to the composite sectoral good, i.e., $\left[\sum_k \beta_{DO}^{ijk}\left(DO^{ijk}\right)^{\rho_{DO}^{ij}}\right]^{\frac{1}{\rho_{DY}^{ij}}} = DO^{ij}$. This minimization yields demand functions for domestically produced and imported goods DO^{ijk} :

$$DO^{ijk} = \left[\frac{P_O^{ik}}{\beta_{DO}^{ijk} P_O^{ij}}\right]^{\frac{1}{\rho_{DO}^{ij}-1}} DO^{ij},$$

where the price indexes P_O^{ij} for the composite good O are

$$P_O^{ij} = \left[\sum_k \left[\left(\beta_{DO}^{ijk}\right)^{-\frac{1}{\rho_{DO}^{ij}}} P_O^{ik}\right]^{\frac{\rho_{DO}^{ij}}{\rho_{DO}^{ij}-1}}\right]^{\frac{\rho_{DO}^{ij}-1}{\rho_{DO}^{ij}}}.$$

A.2 Producers

For the United States, Mexico, and Canada, we assume Cobb-Douglas production function (elasticity of substitution of one) for the manufacturing and service & construction sectors and constant elasticity of substitution (CES) production functions for the capital- and labor-intensive agricultural sectors.

A.2.1 US Manufacturing Sector

The production function in the US manufacturing sector is

$$SY^U = A_Y^U \left[\left(K_Y^U\right)^{\alpha_Y^U} \left(L_Y^{UE}\right)^{\gamma_Y^U} \right]^{\zeta_Y^U},$$

where A_Y^U is total factor productivity, α_Y^U and γ_Y^U are share parameters, and ζ_Y^U is the return-to-scale parameter. The sectoral profit function is

$$\Pi_Y^U = P_Y SY^U - r^U K_Y^U - w^{UE} L_Y^{UE}.$$

Solving the profit maximization problem yields input demand functions:

$$\begin{aligned} L_Y^{UE} &= \left(\frac{\gamma_Y^U \zeta_Y^U}{w^{UE}}\right)^{\frac{1-\alpha_Y^U \zeta_Y^U}{1-\zeta_Y^U}} \left(\frac{\alpha_Y^U \zeta_Y^U}{r^U}\right)^{\frac{\alpha_Y^U \zeta_Y^U}{1-\zeta_Y^U}} \left[P_Y A^U\right]^{\frac{1}{1-\zeta_Y^U}}, \\ K_Y^U &= \left(\frac{\gamma_Y^U \zeta_Y^U}{w^{UE}}\right)^{\frac{\gamma_Y^U \zeta_Y^U}{1-\zeta_Y^U}} \left(\frac{\alpha_Y^U \zeta_Y^U}{r^U}\right)^{\frac{1-\gamma_Y^U \zeta_Y^U}{1-\zeta_Y^U}} \left[P_Y A^U\right]^{\frac{1}{1-\zeta_Y^U}}. \end{aligned}$$

A.2.2 US Service & Construction sector

The production function for the US service & construction sector is

$$SV^U = A_V^U \left[\left(K_V^U\right)^{\alpha_V^U} \left(L_V^{UE}\right)^{\gamma_V^U} \left(L_V^{UN}\right)^{\beta_V^U} \left(L_V^{UI}\right)^{\upsilon_V^U} \right]^{\zeta_V^U}.$$

The profit function for this sector is

$$\Pi_V^U = P_V^U SV^U - r^U K_V^U - w^{UE} L_V^{UE} - w^{UN} L_V^{UN} - w^{UI} L_V^{UI} - dcL_V^{UI}.$$

Multiplying the wage linkage, $w^{UG} = w^{UI} + dc$, through by L_V^{UI} yields $w^{UG} L_V^{UI} = w^{UI} L_V^{UI} + dcL_V^{UI}$. Then, substituting this expression in the profit function gives

$$\Pi_V^U = P_V^U SV^U - r^U K_V^U - w^{UE} L_V^{UE} - w^{UN} L_V^{UN} - w^{UG} L_V^{UI}.$$

Solving the first-order conditions of profit maximization yields input demand functions:

$$\begin{aligned}
K_V^U &= \frac{\zeta_V^U \alpha_V^U P_V^U A_V^U}{r^U} \left[\left[\frac{\zeta_V^U \alpha_V^U P_V^U A_V^U}{r^U} \right]^{\alpha_V^U} \left[\frac{\zeta_V^U \gamma_V^U P_V^U A_V^U}{w^{UE}} \right]^{\gamma_V^U} \left[\frac{\zeta_V^U \beta_V^U P_V^U A_V^U}{w^{UN}} \right]^{\beta_V^U} \left[\frac{\zeta_V^U \upsilon_V^U P_V^U A_V^U}{w^{UG}} \right]^{\upsilon_V^U} \right]^{\frac{\zeta_V^U}{1-\zeta_V^U}}, \\
L_V^{UE} &= \frac{\zeta_V^U \gamma_V^U P_V^U A_V^U}{w^{UE}} \left[\left[\frac{\zeta_V^U \alpha_V^U P_V^U A_V^U}{r^U} \right]^{\alpha_V^U} \left[\frac{\zeta_V^U \gamma_V^U P_V^U A_V^U}{w^{UE}} \right]^{\gamma_V^U} \left[\frac{\zeta_V^U \beta_V^U P_V^U A_V^U}{w^{UN}} \right]^{\beta_V^U} \left[\frac{\zeta_V^U \upsilon_V^U P_V^U A_V^U}{w^{UG}} \right]^{\upsilon_V^U} \right]^{\frac{\zeta_V^U}{1-\zeta_V^U}}, \\
L_V^{UN} &= \frac{\zeta_V^U \beta_V^U P_V^U A_V^U}{w^{UN}} \left[\left[\frac{\zeta_V^U \alpha_V^U P_V^U A_V^U}{r^U} \right]^{\alpha_V^U} \left[\frac{\zeta_V^U \gamma_V^U P_V^U A_V^U}{w^{UE}} \right]^{\gamma_V^U} \left[\frac{\zeta_V^U \beta_V^U P_V^U A_V^U}{w^{UN}} \right]^{\beta_V^U} \left[\frac{\zeta_V^U \upsilon_V^U P_V^U A_V^U}{w^{UG}} \right]^{\upsilon_V^U} \right]^{\frac{\zeta_V^U}{1-\zeta_V^U}}, \\
L_V^{UT} &= \frac{\zeta_V^U \upsilon_V^U P_V^U A_V^U}{w^{UG}} \left[\left[\frac{\zeta_V^U \alpha_V^U P_V^U A_V^U}{r^U} \right]^{\alpha_V^U} \left[\frac{\zeta_V^U \gamma_V^U P_V^U A_V^U}{w^{UE}} \right]^{\gamma_V^U} \left[\frac{\zeta_V^U \beta_V^U P_V^U A_V^U}{w^{UN}} \right]^{\beta_V^U} \left[\frac{\zeta_V^U \upsilon_V^U P_V^U A_V^U}{w^{UG}} \right]^{\upsilon_V^U} \right]^{\frac{\zeta_V^U}{1-\zeta_V^U}}.
\end{aligned}$$

A.2.3 US Capital-Intensive Agriculture

The share form[1] of the CES production technology of US capital-intensive agriculture is

$$SX_1^U = A_{X_1}^U \left[\alpha_{X_1}^U \left(\frac{K_{X_1}^U}{\bar{K}_{X_1}^U} \right)^{\lambda_{X_1}^U} + \beta_{X_1}^U \left(\frac{L_{X_1}^{UN}}{\bar{L}_{X_1}^{UN}} \right)^{\lambda_{X_1}^U} \right]^{\frac{\mu_{X_1}^U}{\lambda_{X_1}^U}},$$

[1]The share and general form of CES production function are equivalent, but the share form for the CES production function is easier to calibrate (Rutherford, 2002).

where $\bar{K}^U_{X_1}$ and $\bar{L}^{UN}_{X_1}$ are baseline input levels and $A^U_{X_1}$ is productivity. The sectoral profit function is

$$\Pi^U_{X_1} = P^U_{X_1} SX^U_1 - r^U K^U_{X_1} - w^{UN} L^{UN}_{X_1}.$$

Solving the first-order conditions of profit maximization yields input demand functions:

$$\begin{aligned}
K^U_{X_1} &= \bar{K}^U_{X_1} \left(\frac{\alpha^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} A^U_{X_1}}{\bar{K}^U_{X_1} r^U \lambda^U_{X_1}} \right)^{\frac{1}{1-\lambda^U_{X_1}}} \times \\
&\left[\alpha^U_{X_1} \left(\frac{\alpha^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} A^U_{X_1}}{\bar{K}^U_{X_1} r^U \lambda^U_{X_1}} \right)^{\frac{\lambda^U_{X_1}}{1-\lambda^U_{X_1}}} + \beta^U_{X_1} \left(\frac{\beta^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} A^U_{X_1}}{\bar{L}^{UN}_{X_1} w^{UN} \lambda^U_{X_1}} \right)^{\frac{\lambda^U_{X_1}}{1-\lambda^U_{X_1}}} \right]^{\frac{\mu^U_{X_1} - \lambda^U_{X_1}}{\lambda^U_{X_1}\left(1-\mu^U_{X_1}\right)}}, \\
L^{UN}_{X_1} &= \bar{L}^{UN}_{X_1} \left(\frac{\beta^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} A^U_{X_1}}{\bar{L}^{UN}_{X_1} w^{UN} \lambda^U_{X_1}} \right)^{\frac{1}{1-\lambda^U_{X_1}}} \times \\
&\left[\alpha^U_{X_1} \left(\frac{\alpha^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} B^U_1}{\bar{K}^U_{X_1} r^U \lambda^U_{X_1}} \right)^{\frac{\lambda^U_{X_1}}{1-\lambda^U_{X_1}}} + \beta^U_{X_1} \left(\frac{\beta^U_{X_1} \lambda^U_{X_1} \mu^U_{X_1} P^U_{X_1} A^U_{X_1}}{\bar{L}^{UN}_{X_1} w^{UN} \lambda^U_{X_1}} \right)^{\frac{\lambda^U_{X_1}}{1-\lambda^U_{X_1}}} \right]^{\frac{\mu^U_{X_1} - \lambda^U_{X_1}}{\lambda^U_{X_1}\left(1-\mu^U_{X_1}\right)}}.
\end{aligned}$$

A.2.4 US Labor-Intensive Agriculture

The share form of the CES production function for US labor-intensive agriculture is[2]

$$SX^U_2 = A^U_{X_2} \left[\alpha^U_{X_2} \left(\frac{K^U_{X_2}}{\bar{K}^U_{X_2}} \right)^{\lambda^U_{X_2}} + \beta^U_{X_2} \left(\frac{L^{UN}_{X_2}}{\bar{L}^{UN}_{X_2}} \right)^{\lambda^U_{X_2}} + \upsilon^U_{X_2} \left(\frac{L^{UT}_{X_2}}{\bar{L}^{UT}_{X_2}} \right)^{\lambda^U_{X_2}} \right]^{\frac{\mu^U_{X_2}}{\lambda^U_{X_2}}}.$$

The profit function is

$$\begin{aligned}
\Pi^U_{X_2} &= P^U_{X_2} A^U_{X_2} \left[\alpha^U_{X_2} \left(\frac{K^U_{X_2}}{\bar{K}^U_{X_2}} \right)^{\lambda^U_{X_2}} + \beta^U_{X_2} \left(\frac{L^{UN}_{X_2}}{\bar{L}^{UN}_{X_2}} \right)^{\lambda^U_{X_2}} + \upsilon^U_{X_2} \left(\frac{L^{UT}_{X_2}}{\bar{L}^{UT}_{X_2}} \right)^{\lambda^U_{X_2}} \right]^{\frac{\mu^U_{X_2}}{\lambda^U_{X_2}}} - \\
&\quad r^U K^U_{X_2} - w^{UN} L^{UN}_{X_2} - w^{UG} L^{UG}_{X_2} - w^{UI} L^{UI}_{X_2} - dc L^{UI}_{X_2}.
\end{aligned}$$

[2] Imperfect substitution between US domestic and temporary workers reflects the differences in workers in the production process. These differences could be attributed to different background in education, culture, and reservation-wage. For example, Akerlof and Yellen (1990) show how actual wage falling short of the fair wage affects working effort.

Again, multiplying the wage linkage, $w^{UG} = w^{UI} + dc$, through by $L^{UI}_{X_2}$ yields $w^{UG}L^{UI}_{X_2} = w^{UI}L^{UI}_{X_2} + dcL^{UI}_{X_2}$. With this expression and $L^{UT}_{X_2} = L^{UG}_{X_2} + L^{UI}_{X_2}$, we can redefine the profit function as

$$
\begin{aligned}
\Pi^U_{X_2} \quad = \quad & P^U_{X_2}A^U_{X_2}\left[\alpha^U_{X_2}\left(\frac{K^U_{X_2}}{\bar{K}^U_{X_2}}\right)^{\lambda^U_{X_2}} + \beta^U_{X_2}\left(\frac{L^{UN}_{X_2}}{\bar{L}^{UN}_{X_2}}\right)^{\lambda^U_{X_2}} + \upsilon^U_{X_2}\left(\frac{L^{UT}_{X_2}}{\bar{L}^{UT}_{X_2}}\right)^{\lambda^U_{X_2}}\right]^{\frac{\mu^U_{X_2}}{\lambda^U_{X_2}}} - \\
& r^U K^U_{X_2} - w^{UN}L^{UN}_{X_2} - w^{UG}L^{UT}_{X_2}.
\end{aligned}
$$

From the profit maximization problem, we solve the first-order conditions for input demand functions:

$$
\begin{aligned}
K^U_{X_2} \quad = \quad & \bar{K}^U_{X_2}\left(\frac{\alpha^U_{X_2}\lambda^U_{X_2}\mu^U_{X_2}P^U_{X_2}A^U_{X_2}}{r^U\bar{K}^U_{X_2}\lambda^U_{X_2}}\right)^{\frac{1}{1-\lambda^U_{X_2}}} \times \\
& \left[\alpha^U_{X_2}\left(\frac{\alpha^U_{X_2}}{r^U\bar{K}^U_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}} + \beta^U_{X_2}\left(\frac{\beta^U_{X_2}}{w^{UN}\bar{L}^{UN}_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}} + \upsilon^U_{X_2}\left(\frac{\upsilon^U_{X_2}}{w^G\bar{L}^{UT}_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}}\right]^{\frac{\mu^U_{X_2}-\lambda^U_{X_2}}{\lambda^U_{X_2}\left(1-\mu^U_{X_2}\right)}} \times \\
& \left(\mu^U_{X_2}P^U_{X_2}A^U_{X_2}\right)^{\frac{\left(\mu^U_{X_2}-\lambda^U_{X_2}\right)}{\left(1-\mu^U_{X_2}\right)^2}},
\end{aligned}
$$

$$
\begin{aligned}
L^{UN}_{X_2} \quad = \quad & \bar{L}^{UN}_{X_2}\left(\frac{\beta^U_{X_2}\lambda^U_{X_2}\mu^U_{X_2}P^U_{X_2}A^U_{X_2}}{w^{UN}\bar{L}^{UN}_{X_2}\lambda^U_{X_2}}\right)^{\frac{1}{1-\lambda^U_{X_2}}} \times \\
& \left[\alpha^U_{X_2}\left(\frac{\alpha^U_{X_2}}{r^U\bar{K}^U_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}} + \beta^U_{X_2}\left(\frac{\beta^U_{X_2}}{w^{UN}\bar{L}^{UN}_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}} + \upsilon^U_{X_2}\left(\frac{\upsilon^U_{X_2}}{w^G\bar{L}^{UT}_{X_2}}\right)^{\frac{\lambda^U_{X_2}}{1-\lambda^U_{X_2}}}\right]^{\frac{\mu^U_{X_2}-\lambda^U_{X_2}}{\lambda^U_{X_2}\left(1-\mu^U_{X_2}\right)}} \times \\
& \left(\mu^U_{X_2}P^U_{X_2}A^U_{X_2}\right)^{\frac{\left(\mu^U_{X_2}-\lambda^U_{X_2}\right)}{\left(1-\mu^U_{X_2}\right)^2}},
\end{aligned}
$$

$$
\begin{aligned}
L_{X_2}^{UT} &= \bar{L}_{X_2}^{UT}\left(\frac{\upsilon_{X_2}^{U}\lambda_{X_2}^{U}\mu_{X_2}^{U}P_{X_2}^{U}A_{X_2}^{U}}{w^{UG}\bar{L}_{X_2}^{UT}\lambda_{X_2}^{U}}\right)^{\frac{1}{1-\lambda_{X_2}^{U}}} \times \\
&\left[\alpha_{X_2}^{U}\left(\frac{\alpha_{X_2}^{U}}{r^{U}\bar{K}_{X_2}^{U}}\right)^{\frac{\lambda_{X_2}^{U}}{1-\lambda_{X_2}^{U}}} + \beta_{X_2}^{U}\left(\frac{\beta_{X_2}^{U}}{w^{UN}\bar{L}_{X_2}^{UN}}\right)^{\frac{\lambda_{X_2}^{U}}{1-\lambda_{X_2}^{U}}} + \upsilon_{X_2}^{U}\left(\frac{\upsilon_{X_2}^{U}}{w^{G}\bar{L}_{X_2}^{UT}}\right)^{\frac{\lambda_{X_2}^{U}}{1-\lambda_{X_2}^{U}}}\right]^{\frac{\mu_{X_2}^{U}-\lambda_{X_2}^{U}}{\lambda_{X_2}^{U}\left(1-\mu_{X_2}^{U}\right)}} \times \\
&\left(\mu_{X_2}^{U}P_{X_2}^{U}A_{X_2}^{U}\right)^{\frac{\left(\mu_{X_2}^{U}-\lambda_{X_2}^{U}\right)}{\left(1-\mu_{X_2}^{U}\right)^{2}}}.
\end{aligned}
$$

A.2.5 Mexican and Canadian Manufacturing Sector

Because Mexican and Canadian sectors do not utilize uncodumented workers, we define production technology for both countries simultaneously. Mexican and Canadian manufacturing sectors utilize Cobb-Douglas production functions:

$$SY^{i} = A_{Y}^{i}\left[\left(K_{Y}^{i}\right)^{\alpha_{Y}^{i}}\left(L_{Y}^{iE}\right)^{\gamma_{Y}^{i}}\right]^{\zeta_{Y}^{i}} \quad i = M, C.$$

The profit function is

$$\Pi_{Y}^{i} = P_{Y}^{i}SY^{i} - r^{i}K_{Y}^{i} - w^{iE}L_{Y}^{iE}.$$

The input demand functions are

$$
\begin{aligned}
L_{Y}^{iE} &= \left(\frac{\gamma_{Y}^{i}\zeta_{Y}^{i}}{w^{iE}}\right)^{\frac{1-\alpha_{Y}^{i}\zeta_{Y}^{i}}{1-\zeta_{Y}^{i}}}\left(\frac{\alpha_{Y}^{i}\zeta_{Y}^{i}}{r^{i}}\right)^{\frac{\alpha_{Y}^{i}\zeta_{Y}^{i}}{1-\zeta_{Y}^{i}}}\left[P_{Y}A^{i}\right]^{\frac{1}{1-\zeta_{Y}^{i}}}, \\
K_{Y}^{i} &= \left(\frac{\gamma_{Y}^{i}\zeta_{Y}^{i}}{w^{iE}}\right)^{\frac{\gamma_{Y}^{i}\zeta_{Y}^{i}}{1-\zeta_{Y}^{i}}}\left(\frac{\alpha_{Y}^{i}\zeta_{Y}^{i}}{r^{i}}\right)^{\frac{1-\gamma_{Y}^{i}\zeta_{Y}^{i}}{1-\zeta_{Y}^{i}}}\left[P_{Y}A^{i}\right]^{\frac{1}{1-\zeta_{Y}^{i}}}.
\end{aligned}
$$

A.2.6 Mexican and Canadian Service & Construction Section

The production technology in the Mexican and Canadian service & construction is Cobb-Douglas:

$$SV^{i} = A_{V}^{i}\left[\left(K_{V}^{i}\right)^{\alpha_{V}^{i}}\left(L_{V}^{iE}\right)^{\gamma_{V}^{i}}\left(L_{V}^{iN}\right)^{\beta_{V}^{i}}\right]^{\zeta_{V}^{i}} \quad i = M, C.$$

The profit functions are

$$\Pi_V^i = P_V^i SV^i - r^i K_V^i - w^{iN} L_V^{iN} - w^{iE} L_V^{iE}.$$

Profit maximization yields the input demand functions:

$$\begin{aligned}
K_V^i &= \frac{\alpha_V^i \zeta_V^i P_V^i A_V^i}{r^i} \left[P_V^i A_V^i \left[\frac{\alpha_V^i \zeta_V^i}{r^i} \right]^{\alpha_V^i} \left[\frac{\gamma_V^i \zeta_V^i}{w^{iH}} \right]^{\eta_H} \left[\frac{\beta_V^i \zeta_V^i}{w^{iL}} \right]^{\beta_V^i} \right]^{\frac{\zeta_V^i}{1-\zeta_V^i}}, \\
L_V^{iE} &= \frac{\gamma_V^i \zeta_V^i P_V^i A_V^i}{w^{iE}} \left[P_V^i A_V^i \left[\frac{\alpha_V^i \zeta_V^i}{r^i} \right]^{\alpha_V^i} \left[\frac{\gamma_V^i \zeta_V^i}{w^{iE}} \right]^{\gamma_V^i} \left[\frac{\beta_V^i \zeta_V^i}{w^{iN}} \right]^{\beta_V^i} \right]^{\frac{\zeta_V^i}{1-\zeta_V^i}}, \\
L_V^{iN} &= \frac{\beta_V^i \zeta_V^i P_V^i A_V^i}{w^{iN}} \left[P_V^i A_V^i \left[\frac{\alpha_V^i \zeta_V^i}{r^i} \right]^{\alpha_V^i} \left[\frac{\gamma_V^i \zeta_V^i}{w^{iE}} \right]^{\gamma_V^i} \left[\frac{\beta_V^i \zeta_V^i}{w^{iN}} \right]^{\beta_V^i} \right]^{\frac{\zeta_V^i}{1-\zeta_V^i}}.
\end{aligned}$$

A.2.7 Mexican and Canadian Capital-Intensive Agriculture

For Mexican and Canadian capital-intensive agriculture, the share form of the CES production functions are

$$SX_1^i = A_{X_1}^i \left[\alpha_{X_1}^i \left(\frac{K_{X_1}^i}{\bar{K}_{X_1}^i} \right)^{\lambda_{X_1}^i} + \beta_{X_1}^i \left(\frac{L_{X_1}^{iN}}{\bar{L}_{X_1}^{iN}} \right)^{\lambda_{X_1}^i} \right]^{\frac{\mu_{X_1}^i}{\lambda_{X_1}^i}} \quad i = M, C.$$

The profit functions are

$$\Pi_{X_1}^i = P_{X_1}^i SX_1^i - r^i K_{X_1}^i - w^{iN} L_{X_1}^{iN}.$$

The sectoral input demand functions are

$$\begin{aligned} K^i_{X_1} &= \bar{K}^i_{X_1}\left(\frac{\alpha^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}A^i_{X_1}}{\bar{K}^i_{X_1}r^i\lambda^i_{X_1}}\right)^{\frac{1}{1-\lambda^i_{X_1}}}\times \\ &\left[\alpha^i_{X_1}\left(\frac{\alpha^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}A^i_{X_1}}{\bar{K}^i_{X_1}r^i\lambda^i_{X_1}}\right)^{\frac{\lambda^i_{X_1}}{1-\lambda^i_{X_1}}}+\beta^i_{X_1}\left(\frac{\beta^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}A^i_{X_1}}{\bar{L}^{iN}_{X_1}w^{iN}\lambda^i_{X_1}}\right)^{\frac{\lambda^i_{X_1}}{1-\lambda^i_{X_1}}}\right]^{\frac{\mu^i_{X_1}-\lambda^i_{X_1}}{\lambda^i_{X_1}\left(1-\mu^i_{X_1}\right)}}, \\ L^{iN}_{X_1} &= \bar{L}^{iN}_{X_1}\left(\frac{\beta^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}A^i_{X_1}}{\bar{L}^{iN}_{X_1}w^{iN}\lambda^i_{X_1}}\right)^{\frac{1}{1-\lambda^i_{X_1}}}\times \\ &\left[\alpha^i_{X_1}\left(\frac{\alpha^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}B^i_{1}}{\bar{K}^i_{X_1}r^i\lambda^i_{X_1}}\right)^{\frac{\lambda^i_{X_1}}{1-\lambda^i_{X_1}}}+\beta^i_{X_1}\left(\frac{\beta^i_{X_1}\lambda^i_{X_1}\mu^i_{X_1}P^i_{X_1}A^i_{X_1}}{\bar{L}^{iN}_{X_1}w^{iN}\lambda^i_{X_1}}\right)^{\frac{\lambda^i_{X_1}}{1-\lambda^i_{X_1}}}\right]^{\frac{\mu^i_{X_1}-\lambda^i_{X_1}}{\lambda^i_{X_1}\left(1-\mu^i_{X_1}\right)}}. \end{aligned}$$

A.2.8 Mexican and Canadian Labor-Intensive Agriculture

The share form of the CES production functions for Mexican and Canadian labor-intensive agriculture are

$$SX^i_2 = A^i_{X_2}\left[\alpha^i_{X_2}\left(\frac{K^i_{X_2}}{\bar{K}^i_{X_2}}\right)^{\lambda^i_{X_2}}+\beta^U_{X_2}\left(\frac{L^{iN}_{X_2}}{\bar{L}^{iN}_{X_2}}\right)^{\lambda^i_{X_2}}\right]^{\frac{\mu^i_{X_2}}{\lambda^i_{X_2}}} \quad i = M, C.$$

The sectoral profit functions are

$$\Pi^i_{X_2} = P^i_{X_2}SX^i_2 - r^iK^i_{X_2} - w^{iN}L^{iN}_{X_2}.$$

The input demand functions are

$$
\begin{aligned}
K_{X_2}^i &= \bar{K}_{X_2}^i \left(\frac{\alpha_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i A_{X_2}^i}{\bar{K}_{X_2}^i r^i \lambda_{X_2}^i} \right)^{\frac{1}{1-\lambda_{X_2}^i}} \times \\
& \left[\alpha_{X_2}^i \left(\frac{\alpha_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i A_{X_2}^i}{\bar{K}_{X_2}^i r^i \lambda_{X_2}^i} \right)^{\frac{\lambda_{X_2}^i}{1-\lambda_{X_2}^i}} + \beta_{X_2}^i \left(\frac{\beta_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i A_{X_2}^i}{\bar{L}_{X_2}^{iN} w^{iN} \lambda_{X_2}^i} \right)^{\frac{\lambda_{X_2}^i}{1-\lambda_{X_2}^i}} \right]^{\frac{\mu_{X_2}^i - \lambda_{X_2}^i}{\lambda_{X_2}^i \left(1-\mu_{X_2}^i\right)}}, \\
L_{X_2}^{iN} &= \bar{L}_{X_2}^{iN} \left(\frac{\beta_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i A_{X_2}^i}{\bar{L}_{X_2}^{iN} w^{iN} \lambda_{X_2}^i} \right)^{\frac{1}{1-\lambda_{X_2}^i}} \times \\
& \left[\alpha_{X_2}^i \left(\frac{\alpha_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i B_2^i}{\bar{K}_{X_2}^i r^i \lambda_{X_2}^i} \right)^{\frac{\lambda_{X_2}^i}{1-\lambda_{X_2}^i}} + \beta_{X_2}^i \left(\frac{\beta_{X_2}^i \lambda_{X_2}^i \mu_{X_2}^i P_{X_2}^i A_{X_2}^i}{\bar{L}_{X_2}^{iN} w^{iN} \lambda_{X_2}^i} \right)^{\frac{\lambda_{X_2}^i}{1-\lambda_{X_2}^i}} \right]^{\frac{\mu_{X_2}^i - \lambda_{X_2}^i}{\lambda_{X_2}^i \left(1-\mu_{X_2}^i\right)}}.
\end{aligned}
$$

A.3 Demand and Supply from ROW

Because North American countries engage in trade with ROW, we include reduced form excess supply and demand functions for the ROW. The ROW exports of traded goods to USMCA countries are

$$SO^R = \delta_O^S \left(P_O^{RR}\right)^{\theta_O^S} \quad O = Y, X_1, X_2, \tag{1}$$

where δ_O^S is a scale parameter and θ_O^S is a supply elasticity. ROW also imports products produced by North American countries, which is represented by the demand fuction

$$DO^{Ri} = \delta_O^D \left(P_O^{iR}\right)^{-\theta_O^D} \quad O = Y, X_1, X_2;\ i = U, M, C, \tag{2}$$

where δ_O^D is a scale parameter and θ_O^D is a demand elasticity.

A.4 Government

The government for each region imposes ad valorem tariffs on imported goods and incurs non-distortionary transfers Tr^i to consumers. The US government also collects fines for hiring undocumented workers labeled as FC^U (note $FC^C = FC^M = 0$). Then the government budget constraints are

$$
\begin{aligned}
G^i = \; & t_Y^{Ui} P_Y^{UU} \left(DY^{iNU} + DY^{iEU}\right) + t_{X_1}^{Ui} P_{X_1}^{UU} \left(DX_1^{iNU} + DX_1^{iEU}\right) + t_{X_2}^{Ui} P_{X_2}^{UU} \left(DX_2^{iNU} + DX_2^{iEU}\right) + \\
& t_Y^{Mi} P_Y^{MM} \left(DY^{iNM} + DY^{iEM}\right) + t_{X_1}^{Mi} P_{X_1}^{MM} \left(DX_1^{iNM} + DX_1^{iEM}\right) + t_{X_2}^{Mi} P_{X_2}^{MM} \left(DX_2^{iNM} + DX_2^{iEM}\right) + \\
& t_Y^{Ci} P_Y^{CC} \left(DY^{iNC} + DY^{iEC}\right) + t_{X_2}^{Ci} P_{X_2}^{CC} \left(DX_2^{iNC} + DX_2^{iEC}\right) + t_{X_1}^{Ci} P_{X_1}^{CC} \left(DX_1^{iNC} + DX_1^{iEC}\right) + \\
& t_{X_2}^{Ri} P_{X_2}^{RR} \left(DX_2^{iNR} + DX_2^{iER}\right) + t_{X_1}^{Ri} P_{X_1}^{RR} \left(DX_1^{iNR} + DX_1^{iER}\right) + t_Y^{Ri} P_Y^{RR} \left(DY^{iNR} + DY^{iER}\right) + \\
& Tr^i + FC^i
\end{aligned}
$$

where t_Y^{Ui}, t_Y^{Mi}, t_Y^{Ci}, t_Y^{Ri}, $t_{X_1}^{Ui}$, $t_{X_1}^{Mi}$, $t_{X_1}^{Ci}$, $t_{X_1}^{Ri}$, $t_{X_2}^{Ui}$, $t_{X_2}^{Mi}$, $t_{X_2}^{Ci}$, and $t_{X_2}^{Ri}$ are tariff rates.

A.5 Market Clearing Conditions

Substituting the government revenue function G^i, ROW demand DO^{Ri} and supply SO^R functions, the demand and supply functions derived above, and the supporting equations in the labor markets[3], into the market clearing conditions below results in a system of 22 market clearing equations with 22 endogenous prices that we solve numerically. The system of 22 equations, with the corresponding

[3] The supporting labor markets equations include $dL^{UI} = (1-b)\, L^I$, $L_S^{CN} = L_{X_1}^{CN} + L_{X_2}^{CN} + L_V^{CN}$, $L_S^{CE} = L_Y^{CE} + L_V^{CE}$, $L_S^{UN} = L_{X_1}^{UN} + L_{X_2}^{UN} + L_V^{UN}$, $L_S^{UE} = L_Y^{UE} + L_V^{UE}$, $L_S^{ME} = L_Y^{ME} + L_V^{ME}$, $L_S^{MN} = L_{X_1}^{MN} + L_{X_2}^{MN} + L_V^{MN}$, and $L^{UI} = L_{X_2}^{UT} + L_V^{UT} - L^{UG}$.

complementary prices in square parentheses next to the equation, is

$$
\begin{aligned}
&[P_Y^{CC}] && SY^C && = DY^{CNC} + DY^{CEC} + DY^{UNC} + DY^{UEC} + DY^{MNC} + DY^{MEC} + DY^{RC} \\
&[P_{X_1}^{CC}] && SX_1^C && = DX_1^{CNC} + DX_1^{CEC} + DX_1^{UNC} + DX_1^{UEC} + DX_1^{MNC} + DX_1^{MEC} + DX_1^{RC} \\
&[P_{X_2}^{CC}] && SX_2^C && = DX_2^{CNC} + DX_2^{CEC} + DX_2^{UNC} + DX_2^{UEC} + DX_2^{MNC} + DX_2^{MEC} + DX_2^{RC} \\
&[P_V^{C}] && SV^C && = DV^{CN} + DV^{CE} \\
&[P_Y^{UU}] && SY^U && = DY^{CNU} + DY^{CEU} + DY^{UNU} + DY^{UEU} + DY^{MNU} + DY^{MEU} + DY^{RU} \\
&[P_{X_1}^{UU}] && SX_1^U && = DX_1^{CNU} + DX_1^{CEU} + DX_1^{UNU} + DX_1^{UEU} + DX_1^{MNU} + DX_1^{MEU} + DX_1^{RU} \\
&[P_{X_2}^{UU}] && SX_2^U && = DX_2^{CNU} + DX_2^{CEU} + DX_2^{UNU} + DX_2^{UEU} + DX_2^{MNU} + DX_2^{MEU} + DX_2^{RU} \\
&[P_V^{U}] && SV^U && = DV^{UN} + DV^{UE} \\
&[P_Y^{MM}] && SY^M && = DY^{CNM} + DY^{CEM} + DY^{UNM} + DY^{UEM} + DY^{MNM} + DY^{MEM} + DY^{RM} \\
&[P_{X_1}^{MM}] && SX_1^M && = DX_1^{CNM} + DX_1^{CEM} + DX_1^{UNM} + DX_1^{UEM} + DX_1^{MNM} + DX_1^{MEM} + DX_1^{RM} \\
&[P_{X_2}^{MM}] && SX_2^M && = DX_2^{CNM} + DX_2^{CEM} + DX_2^{UNM} + DX_2^{UEM} + DX_2^{MNM} + DX_2^{MEM} + DX_2^{RM} \\
&[P_V^{M}] && SV^M && = DV^{MN} + DV^{ME} \\
&[P_Y^{RR}] && SY^R && = DY^{CNR} + DY^{CER} + DY^{UNR} + DY^{UER} + DY^{MNR} + DY^{MER} \\
&[P_{X_1}^{RR}] && SX_1^R && = DX_1^{CNR} + DX_1^{CER} + DX_1^{UNR} + DX_1^{UER} + DX_1^{MNR} + DX_1^{MER} \\
&[P_{X_2}^{RR}] && SX_2^R && = DX_2^{CNR} + DX_2^{CER} + DX_2^{UNR} + DX_2^{UER} + DX_2^{MNR} + DX_2^{MER} \\
&[r] && \overline{K^C} + \overline{K^U} + \overline{K^M} && = K_Y^C + K_{X_1}^C + K_{X_2}^C + K_V^C + K_Y^U + K_{X_1}^U + K_{X_2}^U + K_V^U + K_Y^M + K_{X_1}^M + K_{X_2}^M + K_V^M \\
&[w^{CN}] && \overline{L}^{CN} && = L_S^{CN} + DL^{CN} \\
&[w^{CE}] && \overline{L}^{CE} && = L_S^{CE} + DL^{CE} \\
&[w^{UN}] && \overline{L}^{UN} && = L_S^{UN} + DL^{UN} \\
&[w^{UE}] && \overline{L}^{UE} && = L_S^{UE} + DL^{UE} \\
&[w^{ME}] && \overline{L}^{ME} && = L_S^{ME} + DL^{ME} \\
&[w^{MN}] && \overline{L}^{MN} && = L^I + L^{UI} + L^{UG} + L_S^{MN} + DL^{MN}
\end{aligned}
$$

Once the endogenous prices are solved, all remaining endogenous demand and supply quantities are solved by plugging the solved price into the corresponding equations.

B Data

All data sources and values for exogenous parameters, variables, and endogenous variables under baseline scenario are listed in Table A1, A2, and A3.

B.1 Data collection

The following data are collected from the GTAP 9 database: US and Mexican population, tariff data, and value of input variables, bilateral trade, production, and consumption. Since 55% of the labor-intensive farm workforce is unauthorized (Ruark, 2011), undocumented labor in US labor-intensive agriculture is computed by multiplying low-skilled labor employment data by this percentage. From Passel et al. (2009), the undocumented workers hired in the US service & construction sector is 15.75 times larger than those in US labor-intensive agriculture. Therefore, we use the undocumented labor data in US labor-intensive agriculture times 15.75 to compute the undocumented labor in US service & construction sector. The US low-skilled and undocumented wage rates are collected from the National Agricultural Workers Survey (USDL, 2016). Mexican low-skilled labor wage is from Marosi (2016). Exchange rates are collected from IMF (2016) to convert all values into US dollars. The guest workers data is collected from USDS (2015).

B.2 Endogenous Variable Computations

Here, we discuss the computations of endogenous variables not obtained directly from data. We multiply 365 days by 24 hours to account for all available time to consumers. Leisure is defined as all non-working hours and includes household chores, sleep, etc. We use consumption and price data to compute expenditures for low-skilled and skilled workers. Then, we use the ratio of each worker group's expenditure to their total countries' expenditures as the value of national income share

Table A1: Data and Parameter Sources

Variable Type	Name	Notation	Source
Endogenous Variable under Baseline	Production	SO^i	GTAP 9
	Consumption	DO^{ij}	GTAP 9
	Bilateral Trade	DO^{ik}	GTAP 9
	Output Price	P_O^i	Set to 1
	Wage	w^{ij}	NAWS, USDL, Marosi (2016), Calibration
	Rental	r^i	Set to 1
	Production Input	K_O^i, L_O^{ij}	GTAP 9
	Undocumented Labor	L^{UI}	Calibrated using GTAP 9 data, Ruark (2011) and Pew Center
	Immigration	L^I	Calibration
Exogenous and Policy Variable	Tariff	t_O^{ki}	GTAP 9
	Portion of Migrants caught at the border	b	Calculated from **?**
	Fraction of deportation	d	Calculated from **?**
	Labor endowment	$\bar{L}^{ij}$	World Bank
	Capital endowment	$\bar{K}^i$	GTAP 9
	Guest Workers	L_O^{UG}	USDS (2015)
	Immigration Cost	g	Calibration
	Fine	c	Calibration
	National Income share	Ψ^{ij}	Calibration
	Labor Share	$\frac{L^{iN}}{L^{iE}}$	OECD
Function Parameter	Utility and Composite Goods CES	ρ^{ij}, ρ_O^{ij}	Assumption
	Production CES	λ_O^i	Assumption
	Production Return to Scale	$\mu_{X_2}^U$	Calibration
	ROW demand/Supply Elasticity	$\theta_O^{D/S}$	Assumption
	ROW demand/Supply Scale	$\delta_O^{D/S}$	Calibration

Table A2: Bilateral Trade and Tariff under USMCA/NAFTA

Origin \ Destination	US	ME	CA	ROW
Manufacturing Tariff (%)				
US	0	0.1	0	3.2
ME	0	0	0	2
CA	0	0	0	1.9
ROW	1.7	4	2	2.5
Capital Intensive Agricultural Tariff (%)				
US	0	0.5	14.7	19
ME	0.2	0	6.2	11.7
CA	1.3	1.7	0	11.8
ROW	2.3	10.3	12.5	7.7
Labor Intensive Agricultural Tariff (%)				
US	0	5.1	0	10.3
ME	0	0	0	2.3
CA	0	0	0	19.5
ROW	0.3	5.3	0.6	5.9
Manufacturing Bilateral Trade (Million US $)				
US	6,387,333.00	156,732.80	207,869.90	975,601.70
ME	238,851.00	388,862.20	13,821.00	71,671.80
CA	268,574.70	5,740.50	561,349.30	105,551.30
ROW	1,673,165.00	116,395.80	140,447.60	11,742,065.00
Capital-Intensive Agricultural Bilateral Trade (Million US $)				
US	1,104,832.9	20,298.70	20,379.60	148,563.20
ME	11,622.70	159,205.00	313.80	5,327.20
CA	23,302.20	2,117.70	145,108.70	24,700.70
ROW	83,907.60	6,351.10	12,357.60	1,131,815.00
Labor-Intensive Agricultural Bilateral Trade (Million US $)				
US	57,784.80	1,210.10	4,622.20	10,048.50
ME	10,613.90	7.481.90	978.20	785.90
CA	1,932.40	54.10	2,087.60	2,961.70
ROW	10,676.90	267.30	1,296.30	117,295.70

Source: Aguiar et al. (2016)

Table A3: Values of Variables and Parameters

Parameter		US	ME	CA	ROW
Aggregate Production (Million US $)	Manu.	7,711,229.40	710,210.80	939,146.20	1,873,226.30
	Capital-Int. Ag.	1,290,432.22	175,908.17	189,374.73	87,249.75
	Labor-Int. Ag.	73,635.55	19,305.30	7,018.14	11,025.93
	Service & Construction	18,848,78	1,068,32	1,983,59	-
Price	Manu.	1	1	1	1
	Capital-Int. Ag.	1	1	1	1
	Labor-Int. Ag.	1	1	1	1
	Service & Const.	1	1	1	-
Wage ($/hour)	Low-Skilled	10.33	1.50	10.33	-
	Skilled	31.60	11.43	19.76	-
	Undocumented	8.98	-	-	-
	Guest Worker	10.33	-	-	-
	Rental Rate	1	1	1	-
Immigration Policy	Portion of Migrants caught at the border	50%	-	-	-
	Fraction of deportation	1.5%	-	-	-
CES Composite Goods	Low-skilled Manu.	0.60	0.60	0.60	-
	Skilled Manu.	0.60	0.60	0.60	-
	Low-skilled Capital-Int. Ag.	0.60	0.60	0.60	-
	Skilled Capital-Int. Ag.	0.60	0.60	0.60	-
	Low-skilled Capital Labor Ag.	0.60	0.60	0.60	-
	Skilled Capital Labor Ag.	0.60	0.60	0.60	-
CES Utility	Low-skilled	-0.50	-0.50	-0.50	-
	Skilled	-0.50	-0.50	-0.50	-
CES low-Skilled worker's composite goods	Manu.	0.6	0.6	0.6	-
	Capital-Int. Ag.	0.6	0.6	0.6	-
	Labor-Int. Ag.	0.6	0.6	0.6	-
CES skilled worker's composite goods	Manu.	0.6	0.6	0.6	-
	Capital-Int. Ag.	0.6	0.6	0.6	-
	Labor-Int. Ag.	0.6	0.6	0.6	-
Skilled Labor Share		0.424	0.15	0.51	-
Labor Endowment	Low-Skilled (hour)	1,572,258.8	889,052.4	143,709.6	-
	Skilled (hour)	1,157,357.2	156,891.6	149,575.2	-
Capital Input	Manu.	798,628.6	151,673.4	159,363.9	-
	Capital-Int. Ag.	151,779	48,471.9	29,255.2	-
	Labor-Int. Ag.	12,892.4	1,250.6	3,880.6	-
	Service & Const.	2,933,848	358,253.4	474,910.5	-
Low-Skilled Labor Input	Capital-Int. Ag.	192,910.7	21,270.6	27,061.0	-
	Labor-Int. Ag.	13,953.5	6,327.7	1,187.1	-

$(\Psi^{ij},\ i = U, M,\ j = N, E)$. Other price variables are solved by using the price linkage functions:

$$
\begin{aligned}
w^{UI} &= w^{MN}\left(1 + \frac{d}{1-b}\right) + \frac{d}{1-b}g \\
w^{UG} &= w^{UI} + dc \\
P_Y^{CU} &= t_Y^{CU} P_Y^{CC} \\
P_{X_1}^{CM} &= t_{X_1}^{CM} P_{X_1}^{CC} \\
P_{X_2}^{CR} &= t_{X_2}^{CR} P_{X_2}^{CC} \\
P_Y^{UC} &= t_Y^{UC} P_Y^{UU} \\
P_{X_1}^{UM} &= t_{X_1}^{UM} P_{X_1}^{UU} \\
P_{X_2}^{UR} &= t_{X_2}^{UR} P_{X_2}^{UU} \\
P_Y^{MU} &= t_Y^{MU} P_Y^{MM} \\
P_{X_1}^{MC} &= t_{X_1}^{MC} P_{X_1}^{MM} \\
P_{X_2}^{MR} &= t_{X_2}^{MR} P_{X_2}^{MM} \\
P_Y^{RC} &= t_Y^{RC} P_Y^{RR} \\
P_{X_1}^{RC} &= t_{X_1}^{RC} P_{X_1}^{RR} \\
P_{X_2}^{RC} &= t_{X_2}^{RC} P_{X_2}^{RR} \\
P_Y^{RU} &= t_Y^{RU} P_Y^{RR} \\
P_{X_1}^{RU} &= t_{X_1}^{RU} P_{X_1}^{RR} \\
P_{X_2}^{RU} &= t_{X_2}^{RU} P_{X_2}^{RR} \\
P_Y^{RM} &= t_Y^{RM} P_Y^{RR} \\
P_{X_1}^{RM} &= t_{X_1}^{RM} P_{X_1}^{RR} \\
P_{X_2}^{RM} &= t_{X_2}^{RM} P_{X_2}^{RR}.
\end{aligned}
$$

C Calibration

Next, we discuss the calibration of parameters. As consistent with all large scale computable general equilibrium models (e.g., Kehoe and Ruhl, 2009), we define quantities such that capital rent, all Mexican commodity prices, and the US service & construction price are one in the baseline. Based on the data in **?**, we set the fraction of undocumented workers deported by the US government (d) as 1.5% and the percentage of unauthorized immigrants being caught at the border and returned back to Mexico (b) as 50%. We assume the elasticity of substitution parameters in the CES production to be $\lambda^U_{X_1} = \lambda^U_{X_2} = \lambda^M_{X_1} = \lambda^M_{X_2} = -1.85$ and ROW price elasticity of demand and supply to be -0.3 and 0.3, respectively. We consider goods from different sectors and leisure are complementary to consumers by assuming utility CES parameter $\rho^{ij} = -0.5$. By contrast, goods of one sector produced in different countries are substitutes in consumption, we assume composite goods elasticity of substitution parameter $\rho^{ij}_{DO} = 0.6$.

C.1 Supply Parameters

The CES and Cobb-Douglas production share parameters (α^i_Y, α^i_V, $\alpha^i_{X_1}$, $\alpha^i_{X_2}$, β^i_V, $\beta^i_{X_1}$, $\beta^i_{X_2}$,γ^i_Y, γ^i_V, υ^U_V, $\upsilon^U_{X_2}$, α^M_Y, $i = U, M, C$) are calibrated as the share of the input cost to the total production cost. For example, in the US capital-intensive agricultural sector, the capital rental cost is $r^U K^U_{X_1}$ and the total cost of production is $r^U K^U_{X_1} + w^{UN} L^{UN}_{X_1}$. Then, the capital share parameter for this sector is $\alpha^U_{X_1} = \frac{r^U K^U_{X_1}}{r^U K^U_{X_1} + w^{UN} L^{UN}_{X_1}}$. The return to scale parameters (ζ^i_Y, $\mu^i_{X_1}$, $\mu^i_{X_2}$, ζ^i_V, $i = U, M, C$) are computed by dividing total cost of production by the value of production. For example, the return-to-scale parameter for the US capital-intensive agricultural sector is $\mu^U_{X_1} = \frac{r^U K^U_{X_1} + w^{UN} L^{UN}_{X_1}}{P^U_{X_1} S X^U_1}$. Given total production, inputs, share parameters, and returns-to-scale parameters, productivity parameters (A^i_Y, $A^i_{X_1}$, $A^i_{X_2}$, A^i_V, $i = U, M, C$) are calculated as residuals of their production functions. For example, US capital-intensive agricultural productivity parameter is calculated as

$$A^U_{X_1} = \frac{SX^U_1}{\left[\alpha^U_{X_1}\left(\frac{K^U_{X_1}}{\bar{K}^U_{X_1}}\right)^{\lambda^U_{X_1}} + \beta^U_{X_1}\left(\frac{L^{UN}_{X_1}}{\bar{L}^{UN}_{X_1}}\right)^{\lambda^U_{X_1}}\right]^{\frac{\mu^U_{X_1}}{\lambda^U_{X_1}}}}.$$ [4]

C.2 Demand Parameters

Following Rutherford (2002), we calibrate the utility share parameters as $\beta^{ij}_{DO} = \frac{P^{ij}_O\left(DO^{ij}\right)^{1-\rho^{ij}}}{w^{ij}(DL^{ij})^{1-\rho^{ij}} + \sum_O P^{ij}_O(DO^{ij})^{1-\rho^{ij}}}$ and $\beta^{ij}_{DL} = 1 - \sum_O \beta^{ij}_{DO}$ and composite goods share parameters as $\beta^{ijk}_{DO} = \frac{P^{ik}_O\left(DO^{ijk}\right)^{1-\rho^{ijk}}}{\sum_k P^{ik}_O\left(DO^{ijk}\right)^{1-\rho^{ijk}}}$.

C.3 Other Parameters

Given value of labor and low-skilled wage data, we calibrate skilled wage to match percentage of the population with education beyond a high school level. US, Mexican, and Canadian adult population with education level beyond high school is collected from OECD (2018). With the data on the wage rates and domestic and border control policies, cost of immigration g is calibrated using the wage-linkage equation $g = w^{UI}\frac{1-b}{d} - w^M\left(\frac{1-b}{d} + 1\right)$. Using the data on the wage rates and domestic control policy, fines to employers c are calibrated by utilizing the wage-linkage equation $c = \frac{1}{d}\left(w^U - w^I\right)$.

D Baseline Values

Table A5 presents the actual volumes of domestic sales and bilateral trade flow, total production, and total consumption under the scenario without the trade agreement and impacts of USMCA. The exporting countries are listed in the first column and importing countries are listed in the top row. Table A6 includes the commodity prices. Table A7 reports the actual values of all types of labor employment. Table A8 presents the actual values of consumption, wage, and welfare of low-skilled and skilled workers under the scenario without the trade agreement and impacts of USMCA.

[4] We follow Rutherford (2002) to calibrate the share and productivity parameters for the share-form CES production functions.

Table A5: Actual Values Under the MNF Scenario of Domestic Sales and Bilateral Trade

		US	ME	CA	ROW	Total Production
US	Manu.	6.43 Mil	0.14 Mil	0.18 Mil	0.93 Mil	7.687 Mil
	Cap-Int Ag.	1.12 Mil	14,271.6	14,252.9	0.14 Mil	1.287 Mil
	Lab-Int Ag.	59,507.9	1,059.53	3,392.27	9,804.73	73,764.4
	Serv./Cons.	18.91 Mil	-	-	-	18.91 Mil
ME	Manu.	0.24 Mil	0.39 Mil	12,904.4	67,695.0	0.71 Mil
	Cap-Int Ag.	8,375.18	0.16 Mil	241.26	4,754.98	0.17 Mil
	Lab-Int Ag.	10,006.7	7,528.06	779.40	737.66	19,051.9
	Serv./Cons.	-	1.05 Mil	-	-	1.05 Mil
CA	Manu.	0.27 Mil	5,579.25	0.56 Mil	0.10 Mil	0.94 Mil
	Cap-Int Ag.	20,699.2	1,795.08	0.15 Mil	21,644.9	0.19 Mil
	Lab-Int Ag.	1,621.48	49.32	2,490.01	2,895.19	7,056.00
	Serv./Cons.	-	-	1.96 Mil	-	1.96 Mil
ROW	Manu.	1.68 Mil	0.11 Mil	0.13 Mil	-	1.92 Mil
	Cap-Int Ag.	73,493.9	5,418.53	10,330.9	-	89,243.4
	Lab-Int Ag.	9,822.92	238.62	1,224.64	-	11,286.2
Total Consumption	Manu.	8.62 Mil	0.64 Mil	0.88 Mil	1.10 Mil	11.25 Mil
	Cap-Int Ag.	1.22 Mil	0.18 Mil	0.17 Mil	0.17 Mil	1.74 Mil
	Lab-Int Ag.	80,959.0	8,875.53	7,886.32	13,437.6	0.11 Mil
	Serv./Cons.	18.91 Mil	1.05 Mil	1.96 Mil	-	21.92 Mil

Notes: [b]Percent changes in results from comparison of USMCA scenario to MFN tariff rates scenario.

Table A6: Actual Values Under the MNF Scenario of Prices

		US	ME	CA	ROW
US	Manu.	1.09	1.11	1.11	1.11
	Cap-Int Agri.	1.09	1.22	1.22	1.12
	Lab-Int Agri.	1.07	1.1	1.28	1.08
	Serv./Cons.	1.1	NA	NA	NA
ME	Manu.	1.1	1.06	1.08	1.1
	Cap-Int Agri.	1.25	1.05	1.18	1.16
	Lab-Int Agri.	1.15	1.04	1.24	1.09
	Serv./Cons.	NA	1.06	NA	NA
CA	Manu.	1.09	1.07	1.05	1.07
	Cap-Int Agri.	1.25	1.17	1.05	1.18
	Lab-Int Agri.	1.17	1.08	1.06	1.06
	Serv./Cons.	NA	NA	1.02	NA
ROW	Manu.	1.11	1.1	1.1	1.11
	Cap-Int Agri.	1.28	1.2	1.21	1.16
	Lab-Int Agri.	1.19	1.11	1.29	1.14

Notes: [a]Simulation results under MFN tariff rates. [b]Percent changes in results from comparison of USMCA scenario to MFN tariff rates scenario.

Table A7: Actual Values Under the MNF Scenario of Labor Employment

		Manuf.	Capita-Int	Labor-Int	Service
US	Skilled	46,177.4	-	-	0.15 Mil
	L-skilled	-	18,424.0	1,262.42	0.25 Mil
	Temp. Workers	-	-	964.98	13,889.1
CA	Skilled	6,291.22	-	-	11,975.4
	L-skilled	-	14,009.5	4,142.85	83,642.6
ME	Skilled	6,823.86	-	-	21,850.78
	L-skilled	-	2,662.28	118.35	24,610.48

Notes: [a]Percent changes in results from comparison of USMCA scenario to MFN tariff rates scenario.

Table A8: Actual Values Under the MNF Scenario of Consumption, Wage Rates, and Welfare

	United States		Mexcio		Canada	
	US L-skilled		US Skilled		ME L-skilled	
Consumption						
Manufacturing	-1.4	-1.14	3.04	3.49	4.34	4.28
Capital Ag	-1.21	-0.94	2.64	3.08	4.09	4.03
Labor Ag.	-1.94	-1.68	1.29	1.73	11.74	11.68
Ser./Con.	-0.52	-0.25	1.73	2.18	1.25	1.19
Leisure	-0.08	-0.07	0.18	0.22	0.14	0.27
Wage						
Undoc wage	-0.54	-	-	-	-	-
Wage	-9.94	-9.6	-3.06	-2.49	-0.6	-0.89
Welfare	-0.38	-0.26	1.05	1.24	1.16	1.21

Notes: [a]Percent changes in results from comparison of USMCA scenario to MFN tariff rates scenario.

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