Online Appendix for "Growth and Trade with Frictions: A Structural Estimation Framework"

by James E. Anderson, Mario Larch, and Yoto V. Yotov

Appendix A Solution of the Upper Level **A2**
A.1 Derivation of the Policy Functions of the Upper Level A2
A.2 Derivation of the Transversality Condition A8

Appendix B Transition **A10**

Appendix C Robustness & Sensitivity Experiments **A14**
C.1 Sensitivity: TFP Controls & Capital Shares A14
C.2 Capital Stocks: Theory vs. Data. A "Smell Test" A14
C.3 Linear Capital Transition Function A15
C.4 Exogenous Growth A17
C.5 Intermediate Goods A18
C.6 Sensitivity to Structural Parameter Values A21

Appendix D Growth and Trade in the Long-Run **A27**

Appendix E ACR Formula **A28**
E.1 ACR Formula In Steady State A30
E.2 ACR Formula Out-of Steady State A31

Appendix F Details to Trade Cost Estimates **A35**

Appendix G Country List and Country Labels **A37**

Appendix H The Growth-and-Trade System in Changes **A38**

Appendix I Counterfactual Procedure **A40**

Appendix J Additional Results for the NAFTA Counterfactual **A43**

Appendix K Linear Capital Accumulation Function **A47**

Appendix L Solution of the Upper Level with Intermediates **A54**
L.1 Derivation of the Policy Functions of the Upper Level with Intermediates . . A54
L.2 Derivation of the Transversality Condition A63

Appendix M Iso-Elastic Utility Function **A65**

A Solution of the Upper Level

A.1 Derivation of the Policy Functions of the Upper Level

Our upper-level specification is very similar to Hercowitz and Sampson (1991) and given by equations (3)-(8), which we repeat here for the convenience of the reader:

$$\begin{aligned}
\max_{\{C_{j,t},\Omega_{j,t}\}} & \quad \sum_{t=0}^{\infty} \beta^t \ln(C_{j,t}) && \text{(A1)}\\
K_{j,t+1} &= \Omega_{j,t}^{\delta} K_{j,t}^{1-\delta}, \ \forall t && \text{(A2)}\\
Y_{j,t} &= p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha}, \ \forall t && \text{(A3)}\\
E_{j,t} &= P_{j,t} C_{j,t} + P_{j,t} \Omega_{j,t}, \ \forall t && \text{(A4)}\\
E_{j,t} &= \phi_{j,t} Y_{j,t}, \ \forall t && \text{(A5)}\\
K_{j,0} & \quad \text{given.} && \text{(A6)}
\end{aligned}$$

As discussed in detail in Heer and Maußner (2009, chapter 1), this specific set-up with logarithmic utility and log-linear adjustment costs has the advantage of obtaining an analytical solution. To solve for the policy function of capital, investment, and consumption, we first solve for $C_{j,t}$ using equation (A4), leading to $C_{j,t} = E_{j,t}/P_{j,t} - \Omega_{j,t}$. Next, use $E_{j,t} = \phi_{j,t} Y_{j,t}$ and plug in $Y_{j,t}$ as given by equation (A3), leading to $C_{j,t} = \left(\phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha}\right)/P_{j,t} - \Omega_{j,t}$. Then, use equation (A2) to replace $\Omega_{j,t}$, leading to $C_{j,t} = \left(\phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha}\right)/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}$ and to the following objective function:

$$\max_{\{K_{j,t}\}} \sum_{t=0}^{\infty} \beta^t \ln\left[\left(\phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha}\right)/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}\right].$$

The corresponding first-order conditions are:

$$\frac{\beta^t}{C_{j,t}}\left(\frac{\alpha \phi_{j,t} Y_{j,t}}{P_{j,t} K_{j,t}} - \frac{(\delta-1)}{\delta} K_{j,t+1}^{1/\delta} K_{j,t}^{-1/\delta}\right) - \frac{1}{\delta}\frac{\beta^{t-1}}{C_{j,t-1}} K_{j,t-1}^{(\delta-1)/\delta} K_{j,t}^{1/\delta-1} \stackrel{!}{=} 0,$$

which hold for all j's and t's. Simplify:

$$\frac{\delta\beta C_{j,t-1}}{C_{j,t}}\left(\frac{\alpha \phi_{j,t} Y_{j,t}}{P_{j,t} K_{j,t}} - \frac{(\delta-1)}{\delta} K_{j,t+1}^{1/\delta} K_{j,t}^{-1/\delta}\right) \stackrel{!}{=} K_{j,t-1}^{(\delta-1)/\delta} K_{j,t}^{1/\delta-1}. \tag{A7}$$

Replace $C_{j,t}$ and $C_{j,t-1}$:

$$\frac{\delta\beta\left(\phi_{j,t-1} Y_{j,t-1}/P_{j,t-1} - \left(K_{j,t}/K_{j,t-1}^{1-\delta}\right)^{1/\delta}\right)}{\left(\phi_{j,t} Y_{j,t}/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}\right)}\left(\frac{\alpha \phi_{j,t} Y_{j,t}}{P_{j,t} K_{j,t}} - \frac{(\delta-1)}{\delta} K_{j,t+1}^{1/\delta} K_{j,t}^{-1/\delta}\right)$$
$$\stackrel{!}{=} K_{j,t-1}^{(\delta-1)/\delta} K_{j,t}^{1/\delta-1} \Rightarrow$$

$$\delta\beta\left(\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\right)\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)$$

$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\Rightarrow$$

$$\delta\beta\left(\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\right)\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)$$

$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t+1}^{1/\delta}\Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-\frac{(\delta-1)\delta\beta}{\delta}\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$

$$-\delta\beta\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}+\frac{\delta\beta(\delta-1)}{\delta}\left(\frac{K_{j,t+1}K_{j,t}}{K_{j,t}K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t+1}^{1/\delta}\Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-(\delta-1)\beta\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$

$$-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}+\beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\stackrel{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t+1}^{1/\delta}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-(\delta-1)\beta\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}+\beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\stackrel{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t+1}^{1/\delta}+\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}K_{j,t}^{1/\delta-1}}{P_{j,t}}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}} - (\delta-1)\beta\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}} + \beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) - K_{j,t+1}^{1/\delta}\right) \Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}} - (\delta-1)\beta\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{(1-\delta)/\delta}P_{j,t-1}} + \beta(\delta-1)K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta}\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) - K_{j,t}K_{j,t+1}^{1/\delta}\right) \Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}} - (\delta-1)\beta\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}} + \beta(\delta-1)K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) - K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta} \Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}} + (1+\beta(\delta-1))K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) + (\delta-1)\beta\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}} \Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}} + (1+\beta(\delta-1))K_{j,t}\frac{K_{j,t}^{(1-\delta)/\delta}}{K_{j,t}^{(1-\delta)/\delta}}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) + (\delta-1)\beta\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}} \Rightarrow$$

$$\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}} + (1+\beta(\delta-1))\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=} \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}(1+\alpha\beta\delta) + (\delta-1)\beta\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}} \Rightarrow$$

$$\alpha\beta\delta + (1+\beta(\delta-1))\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t}P_{j,t-1}}{\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}$$

$$\stackrel{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}}(1+\alpha\beta\delta) + (\delta-1)\beta\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t}}{\phi_{j,t}Y_{j,t}}.$$

Define $B_{j,t-1} \equiv \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}}$:

$$(1+\beta(\delta-1))B_{j,t-1}B_{j,t} - (\delta-1)\beta B_{j,t} \stackrel{!}{=} B_{j,t-1}(1+\alpha\beta\delta) - \alpha\beta\delta.$$

$$B_{j,t} \stackrel{!}{=} \frac{(1+\alpha\beta\delta)B_{j,t-1} - \alpha\beta\delta}{(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta}. \qquad \text{(A8)}$$

Note that $B_{j,t-1} \equiv \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}} = \Omega_{j,t-1}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}} \Rightarrow \Omega_{j,t-1} = B_{j,t-1}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$. Hence, $B_{j,t-1}$ is the share of real expenditure used for investments in country j in period $t-1$ and $1-B_{j,t-1}$ is the share of real expenditure used for consumption in country j in period $t-1$ (as $\phi_{j,t-1}Y_{j,t-1}/P_{j,t-1} = C_{j,t-1} + \Omega_{j,t-1}$). Since $B_{j,t-1}$ is a share, it is bounded between zero and one. Note also that equation (A8) holds for all t. There are two steady states for (A8) where $B_{j,t} = B_{j,t-1} = B_j$, which are given by:

$$(1+\beta(\delta-1))B_j^2 - (1+\alpha\beta\delta)B_j - (\delta-1)\beta B_j + \alpha\beta\delta \stackrel{!}{=} 0 \Rightarrow$$

$$B_j^2 - \frac{(1+\alpha\beta\delta+\delta\beta-\beta)}{(1-\beta+\beta\delta)}B_j + \frac{\alpha\beta\delta}{1-\beta+\beta\delta} \stackrel{!}{=} 0 \Rightarrow$$

$$B_j = \frac{1+\alpha\beta\delta+\delta\beta-\beta}{2(1-\beta+\beta\delta)} \pm \left(\frac{(1+\delta\beta-\beta+\alpha\beta\delta)^2}{4(1-\beta+\beta\delta)^2} - \frac{\alpha\beta\delta}{1-\beta+\beta\delta}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{1+\alpha\beta\delta+\delta\beta-\beta}{2(1-\beta+\beta\delta)}$$
$$\pm\left(\frac{(1+\delta\beta-\beta)^2 + 2(1+\delta\beta-\beta)\alpha\beta\delta + (\alpha\beta\delta)^2 - 4(1-\beta+\beta\delta)\alpha\beta\delta}{4(1-\beta+\beta\delta)^2}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{1+\alpha\beta\delta+\delta\beta-\beta}{2(1-\beta+\beta\delta)} \pm \left(\frac{(1+\delta\beta-\beta)^2 - 2(1+\delta\beta-\beta)\alpha\beta\delta + (\alpha\beta\delta)^2}{4(1-\beta+\beta\delta)^2}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{1+\alpha\beta\delta+\delta\beta-\beta}{2(1-\beta+\beta\delta)} \pm \left(\frac{(1+\delta\beta-\beta-\alpha\beta\delta)^2}{4(1-\beta+\beta\delta)^2}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{1+\alpha\beta\delta+\delta\beta-\beta}{2(1-\beta+\beta\delta)} \pm \frac{1+\delta\beta-\beta-\alpha\beta\delta)}{2(1-\beta+\beta\delta)} \Rightarrow$$

$$B_j = \frac{(1+\alpha\beta\delta+\delta\beta-\beta) \pm (1+\delta\beta-\beta-\alpha\beta\delta)}{2(1-\beta+\beta\delta)} \Rightarrow$$

$$B_j^- = \frac{(1+\alpha\beta\delta+\delta\beta-\beta)-(1+\delta\beta-\beta-\alpha\beta\delta)}{2(1-\beta+\beta\delta)} = \frac{\alpha\beta\delta}{1-\beta+\beta\delta}.$$
$$B_j^+ = \frac{(1+\alpha\beta\delta+\delta\beta-\beta)+(1+\delta\beta-\beta-\alpha\beta\delta)}{2(1-\beta+\beta\delta)} = 1.$$

Remember that $\Omega_{j,t-1} = B_{j,t-1}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$. Therefore, $B_j^+ = 1$ implies that $\phi_{j,t-1}Y_{j,t-1} = P_{j,t-1}\Omega_{j,t-1}$, which means that the total amount of expenditure is invested and nothing consumed. This cannot be optimal, as $\ln(0) = -\infty$. It also violates the transversality condition (see Section A.2). Alternatively, $B = B_j^- = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$, implies $\Omega_{j,t-1} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$, which means that a constant share of real expenditure is invested in all countries. It also satisfies the transversality condition (see again Section A.2). We next show that $B_j^- = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$ is an unstable equilibrium. First, linearize equation (A8) around $B_{j,0}$:

$$\begin{aligned} B_{j,t}(B_{j,t-1}) = & \frac{(1+\alpha\beta\delta)\,B_{j,0}-\alpha\beta\delta}{(1+\beta(\delta-1))B_{j,0}-(\delta-1)\beta} \\ & + \frac{\beta(1-\delta(1-\alpha))}{[(1-\beta(1-\delta))B_{j,0}+(1-\delta)\beta]^2}\left(B_{j,t-1}-B_{j,0}\right), \end{aligned}$$

where we used the following expression for the partial derivative of equation (A8) with respect to $B_{j,t-1}$:

$$\begin{aligned} \frac{\partial B_{j,t}}{\partial B_{j,t-1}} = & \frac{(1+\alpha\beta\delta)\left[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta\right]}{[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta]^2} \\ & - \frac{(1+\beta(\delta-1))\left[(1+\alpha\beta\delta)\,B_{j,t-1}-\alpha\beta\delta\right]}{[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta]^2} \\ = & \frac{-(1+\alpha\beta\delta)(\delta-1)\beta+(1+\beta(\delta-1))\alpha\beta\delta}{[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta]^2} \\ = & \frac{-(\delta-1)\beta-\alpha\beta\delta(\delta-1)\beta+\alpha\beta\delta+\beta(\delta-1)\alpha\beta\delta}{[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta]^2} \\ = & \frac{\beta(1+\delta(\alpha-1))}{[(1+\beta(\delta-1))B_{j,t-1}-(\delta-1)\beta]^2} \\ = & \frac{\beta(1-\delta(1-\alpha))}{[(1-\beta(1-\delta))B_{j,t-1}+(1-\delta)\beta]^2}. \end{aligned}$$

Evaluate at point $B_{j,0} = B_j^- = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$:

$$\begin{aligned} B_{j,t}(B_{j,t-1}) = & \frac{(1+\alpha\beta\delta)\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}-\alpha\beta\delta}{(1+\beta(\delta-1))\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}-(\delta-1)\beta} \\ & + \frac{\beta(1-\delta(1-\alpha))}{[(1-\beta(1-\delta))\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}+(1-\delta)\beta]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow \end{aligned}$$

$$B_{j,t}(B_{j,t-1}) = \frac{\alpha\beta\delta\left(\frac{1+\alpha\beta\delta}{1-\beta+\beta\delta}-1\right)}{\alpha\beta\delta-(\delta-1)\beta} + \frac{\beta(1-\delta(1-\alpha))}{[\alpha\beta\delta+(1-\delta)\beta]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow$$

$$B_{j,t}(B_{j,t-1}) = \frac{\alpha\beta\delta\left(\frac{\alpha\beta\delta+\beta-\beta\delta}{1-\beta+\beta\delta}\right)}{\alpha\beta\delta-(\delta-1)\beta} + \frac{(1-\delta+\alpha\delta))}{\beta[\alpha\delta+1-\delta)]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow$$

$$B_{j,t}(B_{j,t-1}) = \frac{\alpha\beta\delta\,(\alpha\beta\delta+\beta-\beta\delta)}{(\alpha\beta\delta+\beta-\beta\delta))\,(1-\beta+\beta\delta)} + \frac{1}{\beta\,(\alpha\delta+1-\delta)}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow$$

$$B_{j,t}(B_{j,t-1}) = \frac{\alpha\beta\delta}{1-\beta+\beta\delta} + \frac{1}{\beta\,[1-\delta\,(1-\alpha)]}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right).$$

The theoretical constraints of the structural parameters $0<\beta<1$, $0<\delta\leq 1$, and $0<\alpha<1$ imply $(\alpha\beta\delta)/(1-\beta+\beta\delta)>0$ and $1/\{\beta\,[1-\delta\,(1-\alpha)]\}>1$. Hence, all values starting above $B^-_{j,t-1}=\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$ will converge to $B^+_j=1$. However, as discussed above, $B^+_j=1$ implies that everything is invested and nothing consumed which is not optimal and violates the transversality condition. Alternatively, all values starting below $B^-_{j,t-1}=\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$, will converge to 0. This implies that nothing is invested, which is not feasible either because in this case the capital stock, output, and income will all be equal to zero (see equations (A2) and (A3)). It follows that $B^-_j=\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$ is *the only* solution of (A8) consistent with the transversality condition and with positive investment and output in each period. Thus, the optimal solution requires $B_{j,t}$ to be constant along the transition path and to be equal to $\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$. Together with $K_{j,t+1}=\Omega^\delta_{j,t}K^{1-\delta}_{j,t}$ and $Y_{j,t}=p_{j,t}A_{j,t}L^{1-\alpha}_{j,t}K^\alpha_{j,t}$, this enables us to express the policy function for capital as:

$$\begin{aligned} K_{j,t+1} &= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\right)^\delta K^{1-\delta}_{j,t} \\ &= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}p_{j,t}A_{j,t}L^{1-\alpha}_{j,t}K^\alpha_{j,t}}{P_{j,t}}\right)^\delta K^{1-\delta}_{j,t} \\ &= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}p_{j,t}A_{j,t}L^{1-\alpha}_{j,t}}{P_{j,t}}\right)^\delta K^{\alpha\delta+1-\delta}_{j,t}. \end{aligned} \tag{A9}$$

Intuitively, (A9) reveals that, alongside parameters, capital accumulation depends on current capital stock $K_{j,t}$, labor endowment $L_{j,t}$, technology $A_{j,t}$, the factory-gate price $p_{j,t}$, and the aggregate price index $P_{j,t}$. A higher labor endowment, a higher current capital stock and a higher technology level translate into higher next-period capital stocks. The relationship between capital stock and the factory-gate price is also positive. As noted in the main text, the intuition is that an increase in the factory-gate price leads to an increase in the value of marginal product of capital and, therefore, to an increase in investment. The relationship between investment and the aggregate price index is inverse. The intuition is that a higher price of investment and a higher price of consumption increase the direct cost and the opportunity cost of investment. A higher current goods price means that output today is more valuable or that more output can be produced today. Hence, consumers are willing to transfer part of their wealth to the next period through capital accumulation. On the other hand, if the current price index is high, consumption and investment are expensive today. Therefore, less will be saved via capital accumulation. Finally, note that equation (A9) can be used to determine the level of investment:

$$\begin{aligned}\Omega_{j,t} &= \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} = \left(\frac{\left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}}{(1-\beta+\beta\delta)P_{j,t}}\right]^{\delta} K_{j,t}^{\alpha\delta+1-\delta}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} \\ &= \left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}}{(1-\beta+\beta\delta)\,P_{j,t}}\right] K_{j,t}^{\alpha} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}. \qquad \text{(A10)}\end{aligned}$$

In addition, the optimal level of current consumption can be obtained by using the policy function for capital and reformulating $E_{j,t} = \phi_{j,t}Y_{j,t} = P_{j,t}C_{j,t} + P_{j,t}\Omega_{j,t}$, i.e.,

$$\begin{aligned}C_{j,t} &= \frac{\phi_{j,t}Y_{j,t}}{P_{j,t}} - \Omega_{j,t} = \frac{\phi_{j,t}Y_{j,t}}{P_{j,t}} - \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}} \\ &= \left(\frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta}\right)\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}} = \left(\frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta}\right)\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{1-\alpha}}{P_{j,t}}. \qquad \text{(A11)}\end{aligned}$$

A.2 Derivation of the Transversality Condition

This section demonstrates that system (A1)-(A6) is a well-behaved dynamic problem that satisfies the following transversality condition, which is defined in the spirit of Acemoglu (2009) (see their equation (6.26) on page 283) and Stokey et al. (1989) (see their equation (3) on page 98):

$$\lim_{t\to\infty} \beta^t \frac{\partial F(x_t^*, x_{t+1}^*)}{\partial x_t} x_t^* = 0,$$

where '*' denotes the solution of the dynamic problem. Start with the following objective function:

$$\max_{\{K_{j,t}\}} \sum_{t=0}^{\infty} \beta^t \ln\left[\left(\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}\right)/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}\right],$$

which only depends on $K_{j,t}$ and $K_{j,t+1}$ alongside exogenous variables for the consumer (such as $p_{j,t}$ and $P_{j,t}$) and parameters. Define

$$F \equiv \ln\left[\left(\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}\right)/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}\right],$$

and express the transversality condition as follows:

$$\lim_{t\to\infty} \beta^t \frac{\partial F(K_{j,t}^*, K_{j,t+1}^*)}{\partial K_{j,t}} K_{j,t}^* = 0.$$

To show that the transversality condition is satisfied, take the derivative of F with respect to $K_{j,t}$ and plug it into the transversality condition:

$$\lim_{t\to\infty} \frac{\beta^t}{C^*_{j,t}} \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{P^*_{j,t} K^*_{j,t}} - \frac{(\delta-1)}{\delta} \left(K^*_{j,t+1}\right)^{1/\delta} \left(K^*_{j,t}\right)^{-1/\delta} \right) K^*_{j,t} =$$
$$\lim_{t\to\infty} \frac{\beta^t}{C^*_{j,t}} \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}} - \frac{(\delta-1)}{\delta} \left(K^*_{j,t+1}\right)^{1/\delta} \left(K^*_{j,t}\right)^{1-1/\delta} \right) =$$
$$\lim_{t\to\infty} \beta^t \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{C^*_{j,t} P^*_{j,t}} - \frac{(\delta-1)\Omega^*_{j,t}}{\delta C^*_{j,t}} \right).$$

Remembering that $\Omega^*_{j,t} = \frac{\alpha\beta\delta}{1-\beta+\beta\delta} \frac{\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}}$, and $C^*_{j,t} = \frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta} \frac{\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}}$, we can replace $\frac{\phi_{j,t} Y^*_{j,t}}{C^*_{j,t} P^*_{j,t}}$ by $\frac{1-\beta+\beta\delta}{1-\beta+\beta\delta-\alpha\beta\delta}$ and $\frac{\Omega^*_{j,t}}{C^*_{j,t}}$ by $\frac{\alpha\beta\delta}{1-\beta+\beta\delta-\alpha\beta\delta}$ to end up with:

$$\lim_{t\to\infty} \beta^t \left(\frac{\alpha-\alpha\beta+\alpha\beta\delta}{1-\beta+\beta\delta-\alpha\beta\delta} - \frac{(\delta-1)\alpha\beta\delta}{\delta\left(1-\beta+\beta\delta-\alpha\beta\delta\right)} \right) =$$
$$\lim_{t\to\infty} \beta^t \left(\frac{\alpha\delta-\alpha\beta\delta+\alpha\beta\delta^2-\alpha\beta\delta^2+\alpha\beta\delta}{\delta(1-\beta+\beta\delta-\alpha\beta\delta)} \right) =$$
$$\lim_{t\to\infty} \beta^t \left(\frac{\alpha}{1-\beta\left(1-\delta\left(1-\alpha\right)\right)} \right) = 0,$$

where the result that the transversality condition holds follows from the theoretical restrictions on the parameters in our model, $0 < \beta < 1$, $0 < \delta \leq 1$, and $0 < \alpha < 1$.

B Transition

An important contribution of our paper is that the assumptions of an intertemporal log-utility function and the log-linear transition function for capital enable us to obtain a closed-form solution for the transition path in the model and to characterize the transition path between steady states. In order to do that, we first calculate the policy function for capital as described in online Appendix A, where consumers take the variety price $p_{j,t}$ and the consumer price $P_{j,t}$ as given. It should be noted that $p_{j,t}$ and $P_{j,t}$ are both general equilibrium indexes that consistently aggregate the decisions of all countries in the world, which are transmitted through changes in trade costs. See discussion in main text for further details. Thus, our policy function gives the optimal decision of consumers for the capital stock tomorrow as a function of prices and the capital stock today, and it is consistent with infinitely forward-looking agents as long as we can determine current prices and have an initial capital stock.

We take the following steps in order to characterize the transition path analytically. First, we calculate the initial capital stock by assuming that we are in a steady state. In particular, we solve our equation system given by equations (20)-(25) simultaneously for all N-countries at steady state. By construction, the steady state is consistent with all prices and steady-state capital stocks for all countries. We take this steady state as our baseline values at time 0. Then, we consider a non-anticipated and permanent change, e.g. a change in bilateral trade costs among Canada, Mexico and the United States due to the formation of NAFTA. Given the current capital stock (which was determined yesterday), we use equations (21)-(24) to solve for new current prices and current GDPs for the new vector of bilateral trade costs. As soon as we have these prices and GDPs, we can calculate the optimal choice of consumption and investment by using the policy function (25). With a new capital stock in the next period, we can again use equations (21)-(24) to solve for next periods prices and GDPs. We then iterate until convergence, i.e., until we reach the new steady state.

It is important to note that equations (21)-(24) solve for prices and income simultaneously for all N-countries in our model. In order to ensure that our calculations are correct, we take two steps. First, we compare the steady state from the iterative procedure with a new steady state that we obtain in one shot, ignoring transition, by simply solving our theoretical system directly with the new vector of trade costs. The two steady states are identical. This is encouraging, but tells us nothing about the transition path. In order to validate the correctness of the transition path calculations, we set-up a system of first-order conditions which we then solve using Dynare. Specifically, we use our utility function:

$$U_{j,t} = \sum_{t=0}^{\infty} \beta^t \ln(C_{j,t}),$$

and combine the budget constraint with the production function:

$$P_{j,t}C_{j,t} + P_{j,t}\Omega_{j,t} = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

Apply the definition of $\Omega_{j,t}$:

$$\Omega_{j,t} = \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}},$$

to obtain the following budget constraint:

$$P_{j,t}C_{j,t} + P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

The corresponding expression for the Lagrangian is:

$$\mathcal{L} = \sum_{t=0}^{\infty}\beta^t\left[\ln(C_{j,t}) + \lambda_{j,t}\left(\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\right)\right].$$

Obtain the first-order conditions with respect to $C_{j,t}$, $K_{j,t+1}$ and $\lambda_{j,t}$:

$$\begin{aligned}
\frac{\partial\mathcal{L}}{\partial C_{j,t}} &= \frac{\beta^t}{C_{j,t}} - \beta^t\lambda_{j,t}P_{j,t} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.\\
\frac{\partial\mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1}\lambda_{j,t+1}\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1} - \beta^t\lambda_{j,t}P_{j,t}\left(\frac{1}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\frac{1}{\delta}K_{j,t+1}^{\frac{1}{\delta}-1}\\
&\quad -\beta^{t+1}\lambda_{j,t+1}P_{j,t+1}K_{j,t+2}^{\frac{1}{\delta}}\frac{\delta-1}{\delta}K_{j,t+1}^{-\frac{1}{\delta}} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.\\
\frac{\partial\mathcal{L}}{\partial\lambda_{j,t}} &= \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.
\end{aligned}$$

Use the first-order condition for consumption to express $\lambda_{j,t}$ as:

$$\lambda_{j,t} = \frac{1}{C_{j,t}P_{j,t}}.$$

Replace this solution in the first-order condition for capital:

$$\begin{aligned}
\frac{\partial\mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1}\frac{1}{C_{j,t+1}P_{j,t+1}}\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1} - \beta^t\frac{1}{C_{j,t}}\left(\frac{1}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\frac{1}{\delta}K_{j,t+1}^{\frac{1}{\delta}-1}\\
&\quad -\beta^{t+1}\frac{1}{C_{j,t+1}}K_{j,t+2}^{\frac{1}{\delta}}\frac{\delta-1}{\delta}K_{j,t+1}^{-\frac{1}{\delta}} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.
\end{aligned}$$

Simplify and re-arrange terms to obtain:

$$\begin{aligned}\frac{\beta\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1}}{C_{j,t+1}P_{j,t+1}} &= \frac{1}{C_{j,t}}\left(\frac{1}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\frac{1}{\delta}K_{j,t+1}^{\frac{1}{\delta}-1} \\ &\quad +\frac{(\delta-1)\,\beta}{\delta C_{j,t+1}}K_{j,t+2}^{\frac{1}{\delta}}K_{j,t+1}^{-\frac{1}{\delta}} \quad \text{for all } j \text{ and } t.\end{aligned}$$

Use the definition of $Y_{j,t}$ to re-write the left-hand side of the above expression as:

$$\frac{\alpha\beta\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}C_{j,t+1}P_{j,t+1}} = \frac{1}{\delta C_{j,t}}\frac{K_{j,t+1}^{\frac{1}{\delta}-1}}{K_{j,t}^{\frac{1-\delta}{\delta}}} + \frac{\beta\,(\delta-1)}{\delta C_{j,t+1}}\left(\frac{K_{j,t+2}}{K_{j,t+1}}\right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t.$$

As expected, we end up with a standard consumption Euler equation. Note that we have four forward-looking variables for each country: $Y_{j,t}$, $K_{j,t}$, $C_{j,t}$ and $P_{j,t}$, i.e., we have $4N$ forward-looking variables in our system. These are, alongside $\Pi_{j,t}$, the endogenous variables we have to solve for. In order to do that, we feed the following set of equations into Dynare:

$$Y_{j,t} = \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j P_{j,t}}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} \quad \text{for all } j \text{ and } t, \tag{A12}$$

$$Y_t = \sum_j Y_{j,t} \quad \text{for all } t, \tag{A13}$$

$$Y_{j,t} = P_{j,t}C_{j,t} + P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t, \tag{A14}$$

$$P_{j,t} = \left[\sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t}\right]^{\frac{1}{1-\sigma}} \quad \text{for all } j \text{ and } t, \tag{A15}$$

$$\Pi_{i,t} = \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{\phi_{j,t}Y_{j,t}}{Y_t}\right]^{\frac{1}{1-\sigma}} \quad \text{for all } i \text{ and } t, \tag{A16}$$

$$\frac{\alpha\beta\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}C_{j,t+1}P_{j,t+1}} = \frac{1}{\delta C_{j,t}}\frac{K_{j,t+1}^{\frac{1}{\delta}-1}}{K_{j,t}^{\frac{1-\delta}{\delta}}} + \frac{\beta\,(\delta-1)}{\delta C_{j,t+1}}\left(\frac{K_{j,t+2}}{K_{j,t+1}}\right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t. \tag{A17}$$

The first equation is the production function from equation (24), where we have replaced $p_{j,t}$ using equation (23). The second equation is the definition of world GDP. The third equation is the budget constraint, where we use equation (2) to replace $\Omega_{j,t}$. The fourth and fifth equations are the MRs as given by equations (21) and (22), respectively, and the last equation is the Euler equation just derived above. We then take as initial and end values the baseline and the counterfactual steady states and we let Dynare solve for the transition of our deterministic model assuming perfect foresight. The algorithm for our case is described in Adjemian et al. (2011) in Section 4.12. Comparison between the transition path from Dynare and the transition path that we solved for analytically reveals that those are identical.

C Robustness & Sensitivity Experiments

This appendix offers a series of sensitivity experiments that gauge the robustness of our results. First, we report the results from several alternative specifications of the *Income equation*. Next we provide a "smell test" of our capital accumulation model. Then, we offer a series of robustness experiments that we performed in order to gauge the sensitivity of the results from our NAFTA counterfactual to relaxing some important theoretical assumptions and to employing alternative values for the key structural parameters in our model. We start by replacing the convenient log-linear capital accumulation function with a more standard linear counterpart. Then, we investigate the effect on NAFTA dynamics of an exogenous increase of the capital stock for the U.S. Third, we repeat the NAFTA counterfactual in the model extended to allow for intermediate goods. Finally, we experiment with different values for the key parameters in our model including country-specific depreciation rates, followed by alternative values for the elasticity of substitution, and for the capital share.

C.1 Sensitivity: TFP Controls & Capital Shares

Table A1 reports results from three alternative specifications of the production function from our structural model, where we introduce additional regressors that are intended to control for TFP. Column (1) of Table A1 reports estimates where we add R&D spending. The new estimates are very similar to our main findings from Table 1. However the number of observations decreases in half. Furthermore, the estimate of the effects of R&D is not statistically significant. Next, in column (2), we add a control for the occurrence of natural disasters. Once again, the new estimates are very similar to those from Table 1, however the estimate on the new control variable is not statistically significant either. We capitalize on the fact that the occurrence of natural disasters has no direct significant effect in the income equation and we employ this variable as an instrument in some of our IV specifications. See main text for further details. Finally, in column (3) of Table A1, we add the controls for R&D and for natural disasters simultaneously and neither of them is statistically significant.

Table A2 allows for heterogeneous effects of capital shares over time and across country-groups. First, we allow capital shares to vary over time. The intuition is that capital shares have increased steadily over the past quarter century and our data should reflect that. In accordance with that, we find that the average capital shares in our sample have increased from 0.441 (std.err. 0.099) during the 1990s to 0.706 (std.err. 0.077) during the 2000s. Next, we distinguish between capital shares in poor versus rich countries. We define rich countries as those with income above the median income in each year of our sample. In accordance with our expectations, we find that production in rich countries is more capital intensive than in poor countries. Specifically, we estimate a statistically significant difference of 7.9 percentage points between the capital shares of the two groups of countries. Overall, we view the estimates from Table A2 as encouraging and in support of our econometric specification for income.

C.2 Capital Stocks: Theory vs. Data. A "Smell Test"

Ottaviano (2015) notes that "validation of calibrated models before simulating them has increasingly gone missing as recent works tend to favor the implementation of "exactly identified" [New Quantitative Trade Models]...Validation requires the calibrated model to be able to match other moments of the data different from those used for calibrating. Simulation of counterfactual scenarios can be reasonably performed only if the calibrated model passes the validation checks." (pp. 174-175). As demonstrated in the main text, our parameter estimates are comparable to corresponding values from existing studies. In addition, our framework provides an opportunity for a "smell test" that compares generated steady-state stocks with stocks in the data for a given year. If the two series diverge widely, it would imply that either the model is bad or the data is far from a steady state. A close fit, however, is taken to indicate good model performance in a world where the capital stocks are not far from the steady state.

The smell test compares our calculated theory-consistent, steady-state capital stocks with the observed capital stocks for 1994 from the Penn World Tables 8.0. Note that we do not assume that 1994 is a steady state and this year was chosen as the year when NAFTA entered into force. Figure 2 plots the calculated stock of capital with the Penn capital stock data. The eyeball closeness of the two series is quantified by a correlation coefficient of 0.98. No formal statistical test is proposed here, but the high correlation is intuitive supporting evidence for the capital accumulation implications of our model.

Figure 2: Theory-Consistent vs. Actual Capital Stocks

C.3 Linear Capital Transition Function

The nice tractability feature of obtaining a closed-form solution for the effects of trade (openness) on capital accumulation in our framework depends crucially on the assumption of a log-linear (Cobb-Douglas) transition function for capital. In this section, we study the limitations of this assumption by replacing the log-linear capital transition function with the standard linear capital transition function:

$$K_{j,t+1} = \Omega_{j,t} + (1-\delta)K_{j,t}.$$

We retain all other assumptions in our model to derive the following trade and growth system:[57]

$$X_{ij,t} = \frac{Y_{i,t}\phi_{j,t}Y_{j,t}}{Y_t}\left(\frac{t_{ij,t}}{\Pi_{i,t}P_{j,t}}\right)^{1-\sigma}, \tag{A18}$$

$$P_{j,t} = \left[\sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t}\right]^{\frac{1}{1-\sigma}}, \tag{A19}$$

$$\Pi_{i,t} = \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{\phi_{j,t}Y_{j,t}}{Y_t}\right]^{\frac{1}{1-\sigma}}, \tag{A20}$$

$$p_{j,t} = \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j\Pi_{j,t}}, \tag{A21}$$

$$Y_{j,t} = p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}, \tag{A22}$$

$$\frac{1}{C_{j,t}} = \frac{\beta}{C_{j,t+1}}\left(\frac{\alpha\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}P_{j,t+1}} + 1 - \delta\right), \tag{A23}$$

$$K_{j,0} \quad \text{given.}$$

Two main features of the new system stand out. First, the only difference between systems (A18)-(A23) and (20)-(25) is equation (A23), which replaces the closed-form solution (25) for the link between trade and capital accumulation in the original system. Second, as expected, equation (A23) no longer represents an analytical expression for next period capital stocks, but rather an implicit relationship that determines consumption. In fact, (A23) is the standard consumption Euler equation, where we have a set of three forward-looking endogenous variables for each country $\{Y_{j,t}$, $C_{j,t}$, and $P_{j,t}\}$.[58]

System (A18)-(A23) no longer lends itself to the iterative method that we used to perform the counterfactuals of interest.[59] Therefore, we rely on Dynare as a standard tool to solve dynamic general equilibrium and overlapping generations models. For consistency with the main analysis, we employ the same data and parameters to simulate the effects of NAFTA once again.[60] To demonstrate the changes due to the new capital accumulation function,

[57] Detailed derivation steps appear in online Appendix K.

[58] $K_{j,t+1}$ is determined in t and therefore not a forward-looking variable.

[59] Note also that with the linear capital accumulation we depart further from Solow, as consumption and expenditure are no longer constant shares of expenditure, even when assuming a log-linear intertemporal utility function.

[60] Note that (A18)-(A23) implies that the estimating equations for trade and output remain unchanged. Therefore, our estimates of the RTA effects, of trade costs, $t_{ij,t}$, of the capital share α, and of the elasticity of substitution σ can be estimated as before and remain unchanged. The only parameter that we can no longer estimate is the capital depreciation rate δ. However, since our estimate of $\delta = 0.061$ is plausible, we retain it in the robustness experiment. Note also that without the closed-form solution for capital accumulation we

we first focus on the transition of capital stocks. Figure 3 contrasts the transition paths for capital stocks for the four countries that we presented in Figure 1, obtained with the log-linear transition function, against the corresponding transition paths for capital stocks for the same countries but this time obtained with the linear capital transition function, which are reported in red color.

Overall, the effects are similar. Three findings stand out. First, the capital accumulation effects generated with the linear transition function are more pronounced immediately after the implementation of NAFTA both for member and for non-member countries. Second, the dynamic NAFTA effects are exhausted a bit faster with the linear capital accumulation function. Third, while the quantitative effects on transition of capital seem different, we hardly find any difference between the welfare effects obtained with the linear versus the log-linear capital transition function. The welfare effects from both cases are reported in Table A3. In the first column we list the country names. The second column reproduces the welfare results from our baseline "Full Dynamic GE, trans." scenario (column (5) of Table 5). The welfare results for the case with the linear capital accumulation function are reported in column (3). Comparison between columns (2) and (3) reveals that the welfare effects are qualitatively identical and quantitatively very similar for the case with our analytical tractable log-linear capital transition function and the more standard linear one. For example, the predicted welfare increase for NAFTA members changes from 2.056% in the log-linear case to 2.059% in the linear case, while the effect on the non-members changes from -0.018% to -0.017%. Based on these estimates, we conclude that replacing the standard linear capital accumulation function with its analytically convenient log-linear counterpart increases the speed of convergence but it has little implications for our estimates of the welfare changes.

C.4 Exogenous Growth

The main mechanism that leads to dynamic effects in our framework is through capital accumulation. Growth affects trade via two channels, directly and indirectly. The direct effect of growth on trade is strictly positive and it is channeled through changes in country size. An increase in the size of an economy results in more exports and in more imports between this country and all its trading partners. It should be emphasized that the increase in size in member countries may actually stimulate exports from non-members to the extent that these effects dominate the standard trade diversion forces triggered by preferential trade liberalization. We find evidence of that in our counterfactual experiments. The indirect effect of growth on trade is channeled trough changes in trade costs. In particular, changes in any country size translate into changes in the multilateral resistances for all countries, which lead to changes in trade flows. Thus the MR channel is a general equilibrium system: i.e., growth in one country will affect trade costs and impact welfare in every other country in the world. The model reveals that growth in a given country translates into lower sellers' incidence on the producers in this country. In addition, all else equal, the benefits of growth in one country are shared with the rest of the world through lower buyers' incidence in its trading partners. The growth-led changes in the sellers' and buyers' incidence of trade costs

no longer can test for causal effects of trade on capital accumulation.

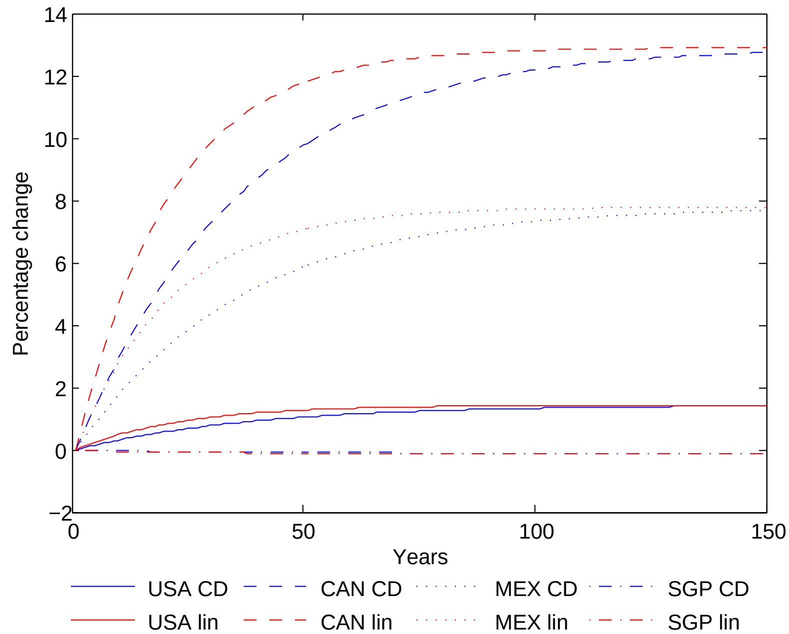

Figure 3: Linear vs. Log-Linear (Cobb-Douglas, CD) Capital Accumulation

lead to additional changes in capital stocks activating further changes in GDP, multilateral resistances, and factory-gate prices.

In order to highlight the growth implications of our model, we study the effects of an exogenous change in the initial stock of capital. In particular, we investigate how the effects of NAFTA will change if, in the presence of NAFTA, the capital stock in the U.S. were 20% larger. The welfare results from this experiment are presented in column (4) of Table A3. Several findings stand out. First, as expected, the largest increase in welfare is seen in the U.S. We find that if the formation of NAFTA was accompanied by a 20% increase of the capital stock in the U.S., welfare in the U.S. would have increased by about 5.1%. The difference to the baseline, which is reported in column (2), is about 4 percentage points. All other countries gain as well. In particular, the positive effects of NAFTA on Canada and Mexico are magnified, while the negative effects on all other countries in the world are diminished. In some cases, we even obtain small welfare gains for outsiders. See, for example, the calculated effects for the Dominican Republic and for Ireland. Finally, we note that the large positive effects for the U.S. and the relatively small positive effects for the other countries fade only slowly over time. In sum, the analysis in this section demonstrates that capital accumulation is very important for the level of welfare in our framework, but even more important for the persistence of the welfare effects over time. The spill-over effects for non-member countries are relatively small, but the persistence of these effects is strong.

C.5 Intermediate Goods

Intermediate inputs represent more than half of the goods imported by the developed economies and close to three-quarters of the imports of some large developing countries, such as China and Brazil (Ali and Dadush, 2011). International production fragmentation and international value chains are less pronounced in some sectors, such as agriculture (Johnson and Noguera, 2012), but extreme in others, e.g. high tech products such as computers (Kraemer and Dedrick, 2002), iPods (Varian, 2007) and aircraft (Grossman and Rossi-Hansberg, 2012). Trade models recognize the important role of intermediate goods for production and trade and introduce intermediates within static settings.[61] In this section we contribute to the related literature by studying the implications of intermediate goods for the dynamic relationships between growth and trade.

To introduce intermediates within our framework, we follow the approach of Eaton and Kortum (2002) and we assume that intermediate inputs are combined with labor and capital via the following Cobb-Douglas production function:[62]

$$Y_{j,t} = p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi} \quad \alpha, \xi \in (0,1), \tag{A24}$$

where, $Q_{j,t} = \left(\sum_i \gamma_i^{\frac{1-\sigma}{\sigma}} q_{ij,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$ is the amount of intermediates used in country j at time t defined as a CES aggregator of domestic components ($q_{jj,t}$) and imported components from all other regions $i \neq j$ ($q_{ij,t}$). Following the steps from our theoretical analysis in Section 3, we obtain the following system that describes the relationship between growth and trade in the presence of intermediate inputs:[63]

$$X_{ij,t} = \frac{Y_{i,t} \phi_{j,t} Y_{j,t}}{Y_t} \left(\frac{t_{ij,t}}{\Pi_{i,t} P_{j,t}} \right)^{1-\sigma}, \tag{A25}$$

$$P_{j,t} = \left[\sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}} \right)^{1-\sigma} \frac{Y_{i,t}}{Y_t} \right]^{\frac{1}{1-\sigma}}, \tag{A26}$$

$$\Pi_{i,t} = \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}} \right)^{1-\sigma} \frac{\phi_{j,t} Y_{j,t}}{Y_t} \right]^{\frac{1}{1-\sigma}}, \tag{A27}$$

$$p_{j,t} = \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j \Pi_{j,t}}, \tag{A28}$$

$$Y_{j,t} = p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}, \tag{A29}$$

$$Q_{j,t} = (1-\alpha-\xi) \frac{\phi_{j,t} Y_{j,t}}{P_{j,t}}, \tag{A30}$$

$$K_{j,t+1} = \left[\frac{\alpha\beta\delta \phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}}{(1-\beta+\beta\delta) P_{j,t}} \right]^{\delta} K_{j,t}^{\alpha\delta+1-\delta}, \tag{A31}$$

$$K_{j,0} \quad \text{given.}$$

The introduction of intermediate goods adds a new layer of indirect and general equilibrium

[61] See for example Eaton and Kortum (2002) and Caliendo and Parro (2015).

[62] We recognize that the use of intermediates vary significantly at the sectoral level as well as across domestic and international inputs, but we leave the dynamic sectoral analysis for future work.

[63] Detailed derivations can be found in online Appendix L.

linkages that shape the relationship between growth and trade. Equation (A29) captures two additional effects of growth on trade, which are channeled through intermediate inputs. First, the effect of own capital accumulation on trade is magnified because $K_{j,t}$ enters the production function (A29) directly, as before, and indirectly, via the intermediates $Q_{j,t}$. Second, and more important, the introduction of intermediates opens a new channel through which foreign capital and foreign capital accumulation enter domestic production (via $Q_{j,t}$). This is an important new link because a change in domestic production will lead to changes in the demand for intermediates from all countries, which also affects trade.

Equation (A31) captures three new channels through which trade affects growth in the case of intermediates. First, the effect of a change in the price of own capital on capital accumulation is magnified because own capital enters the policy function for capital directly, as before, and indirectly, via the intermediate inputs. Second, foreign capital and foreign capital accumulation now enter the policy function for domestic capital via the intermediate inputs. Finally, since foreign goods are used as intermediates and enter equation (A31), any change in their prices will have further effects on domestic capital accumulation.

We are not aware of the existence of international data on the use of intermediate goods at the aggregate level. This makes it impossible to disentangle the shares of labor, capital and intermediates in our Cobb-Douglas production function (A24) empirically. Therefore, we adopt Eaton and Kortum (2002)'s approach and assume a share for intermediates, which we combine with our data for $L_{j,t}$, $Y_{j,t}$, and $t_{ij,t}^{1-\sigma}$ as well as the estimated parameters, to recover the country-specific technological components $A_{j,t}/\gamma_j$. Specifically, we assign a share of intermediates equal to 0.25 at the expense of capital, and we retain the share of labor to 0.455 as in our baseline setting.[64] Then, we replicate our NAFTA counterfactual experiment to quantify the role of intermediates in our dynamic framework.

Column (5) of Table A3 presents the results after allowing for intermediates. Several properties stand out in comparison with the baseline setting from column (2). First, accounting for intermediates in production increases the welfare effects for NAFTA members by 0.248 percentage points on average. For example, Canada's welfare increases by about 1.1 percentage points. This increase is exclusively due to the interaction between intermediate inputs and the dynamic forces in our framework. Very similar additional quantitative implications are found for Mexico and the U.S. Second, we find that the negative effects on non-member countries are also a bit larger. The negative impact of NAFTA on non-members increases by 0.001 percentage points on average. Importantly, we note that the additional negative effect on non-members is not only smaller as compared to the additional gain for members in absolute value, but also as a percent (5.5 percent vs. 12.1 percent). The intuition for this result is that the positive spill-over effects of capital accumulation in member countries that are channeled via the intermediate goods in non-member countries partly offset the negative trade diversion effect in the latter.

In sum, the analysis in this section demonstrates that the introduction of intermediate goods leads to significant changes in the quantitative predictions of our model. The aggregate nature of our study and lack of appropriate data limit our analysis. However, our findings point to clear potential benefits from a more detailed analysis of the dynamic effects of

[64]Introducing intermediates at the expensive of capital will enable us to demonstrate the difference between capital goods and intermediates in our dynamic framework.

intermediate inputs and to additional insights and knowledge to be gained from an extension of our model to the sectoral level.

C.6 Sensitivity to Structural Parameter Values

In this section we investigate the sensitivity of our results with respect to key parameters of our model. In our first experiment, we allow for country-specific capital depreciation rates, which are reported in column (6) of Table A3. We use equation (34) to obtain country-specific depreciation rate estimates δ_i's. To do this, we interact each of the three covariates on the right-hand side of equation (34) with country dummies, and we impose the theoretical constraints of our model. Several properties of our country-specific estimates stand out. With only one exception, all estimates of δ are positive but smaller than one, as assumed in our theory.[65] We also obtain one positive but small and insignificant estimate $\delta_{SDN} = 0.006$ (std.err. 0.012), for Sudan. All other estimates are statistically significant and in the interval (0;1). The mean of the distribution of estimated depreciation rates is $\bar{\delta} = 5.5\%$ (std.dev. 2.3%). We obtain positive and significant, but suspiciously small depreciation estimates (less than 1%) for 2 countries, Vietnam (0.82%) and China (0.99%). The largest estimate that we obtain is $\delta_{GBR} = 10\%$ for Great Britain. Overall, despite the few exceptions, we view the country-specific depreciation estimates as encouraging evidence in support of our model.

The welfare effects of NAFTA in the presence of the country-specific δ's are reported in column (7). As some δ's are lower and some are higher than the benchmark estimate $\hat{\delta} = 0.061$ from the main analysis, an overall assessment of the effects of the country-specific estimates is difficult. In general, a higher δ implies that more capital has to be replaced in every period. This is a burden for an economy. However, the price of the replacement depends on the price for the final good. Lowering trade costs leads to a lower price for the composite final good. This decrease is driven by the direct effect of lower trade costs, leading to lower prices for foreign goods, and due to the larger share of foreign goods used in production. Hence, trade liberalization makes capital replacement cheaper. All else equal, a higher depreciation rate implies larger changes of international trade due to trade liberalization, as more foreign goods are demanded for capital replacement and consumption due to the lower price. Also welfare increases as compared to an analysis with a lower depreciation rate, as the higher depreciation rate implies a larger role for the capital accumulation channel inducing income growth. The effects of trade liberalization are exactly the opposite for a lower depreciation rate. Specifically, for non-liberalizing countries, the negative effects will become stronger for higher δ's and weaker for lower δ's due to the same logic. Consider the case of Great Britain, which is the country with the highest capital depreciation rate, $\hat{\delta} = 0.1$, which is also higher than the baseline average estimate $\hat{\delta} = 0.061$. According to the above logic, one would expect higher welfare losses for Great Britain, and this is exactly what we find. The opposite happens for Sudan, which is the country with the smallest capital depreciation rate, $\delta = 0.006$.

Next, we employ extreme values for the key parameters in our model. In column (8) of Table A3, we use our largest estimate of $\hat{\sigma} = 11.282$. As expected, a higher σ leads to lower

[65] The single exception is Zimbabwe, for which we obtain a negative estimate $\delta_{ZWE} = -0.087$ (Std.err. 0.005). Since a negative depreciation rate is inconsistent with the theoretical restrictions of our model, in the counterfactual experiment we replace the negative value for Zimbabwe with our average estimate $\hat{\delta} = 0.061$.

welfare effects. This is the case because σ directly governs the willingness of consumers to substitute products. A higher σ therefore leads to lower gains from trade, as consumers do not value the availability of foreign goods a lot. On average, the increase of σ from 5.847 to 11.282 leads to a decrease of the welfare effects of about 53%. Next, we set $\alpha = 0.3$, a standard value from the literature (see for example Acemoglu, 2009). As expected, the decrease of the capital share mitigates the dynamic effects in our model. Specifically, this leads to about 24% lower welfare gains for the NAFTA countries as compared to the baseline setting (compare column (2) and column (9) of Table A3). The negative effects on non-NAFTA countries are smaller but disproportionately so. This suggests that, combined with trade liberalization, more intensive use of capital will lead to relatively more gains for member countries.

We finish with two experiments involving the external parameters β (the subjective discount factor) and the intertemporal elasticity of substitution, respectively.[66] Specifically, we set the value of the consumer discount factor to $\beta = 0.95$, which is the value used in Eaton et al. (2016). The lower consumer discount factor results in smaller, but still relatively large, dynamic effects on welfare. The estimates from column (10) of Table A3 reveal that the dynamic welfare gains for NAFTA members decrease by about 21%, while the negative effects on non-members are 17% smaller. The overall smaller dynamic effects that correspond to a smaller discount factor are expected because they reflect the fact that a smaller β means that consumers value the future stream of consumption less. Concerning the intertemporal elasticity of substitution, we change it from one (implied by our logarithmic utility function for instantaneous utility) to 0.5 ($= 1/\rho$) using an iso-elastic utility function for instantaneous utility, a value supported by empirical findings (see Sampson, 2016). A lower willingness to change the intertemporal consumption-investment-decision when relative prices change leads to slightly larger additional dynamic welfare gains. The reason is that a lower intertemporal elasticity of substitution leads to a slower adjustment to the new steady state, implying that there is a higher level of consumption in early years. In combination with discounting of future consumption, this leads to a slightly higher overall dynamic welfare gain.

In sum, the experiments in this section reveal that our results are sensitive to the specification of the key parameters, but the model generates intuitive responses to parameter changes.

[66]Note that our logarithmic utility function implies an intertemporal elasticity of substitution of 1. In online Appendix M we generalize our logarithmic intertemporal utility function to an iso-elastic utility function.

Table A1: Trade, R&D, Disasters, and Income, 1990-2011

	(1)	(2)	(3)
	R&D	Disastr.	R&D & Disastr.
$\ln L_{j,t}$	0.190	0.236	0.190
	(0.041)**	(0.046)**	(0.050)**
$\ln K_{j,t}$	0.403	0.524	0.403
	(0.045)**	(0.042)**	(0.042)**
$\ln\left(\widehat{\Pi_{j,t}^{\sigma-1}}\right)$	-0.141	-0.099	-0.140
	(0.029)**	(0.028)**	(0.021)**
$TFP_{j,t}$	0.456	0.303	0.456
	(0.059)**	(0.110)**	(0.063)**
$R\&D_{j,t}$	0.008		0.008
	(0.014)		(0.013)
$Disastr_{j,t}$		0.165	-0.036
		(0.351)	(0.305)
N	787	1447	787

Notes: This table reports results from three alternative specifications of the production function from our structural model. All specifications include country and year fixed effects whose estimates are omitted for brevity. Column (1) reports estimates where we add R&D spending. In column (2) we add a control for the occurrence of natural disasters. Finally, in column (3) we add the controls for R&D and for natural disasters simultaneously. Robust standard errors in parentheses. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table A2: Heterogeneous Capital Shares

	(1) Time	(2) Development
A. Dep. Variable $\ln Y_{j,t}$		
$\ln L_{j,1990s}$	0.464	
	(0.082)**	
$\ln L_{j,2000s}$	0.243	
	(0.064)**	
$\ln K_{j,1990s}$	0.365	
	(0.082)**	
$\ln K_{j,2000s}$	0.586	
	(0.064)**	
$\ln L_{poor,t}$		0.318
		(0.053)**
$\ln L_{rich,t}$		0.252
		(0.036)**
$\ln K_{poor,t}$		0.511
		(0.053)**
$\ln K_{rich,t}$		0.577
		(0.036)**
$\ln \left(\widehat{\Pi_{j,t}^{\sigma-1}}\right)$	-0.171	-0.171
	(0.018)	(0.018)**
$TFP_{j,t}$	0.303	0.303
	(0.026)	(0.026)
B. Structural Parameters		
$\widehat{\alpha}_{1990s}$	0.441	
	(0.099)**	
$\widehat{\alpha}_{2000s}$	0.706	
	(0.077)**	
$\widehat{\alpha}_{poor}$		0.617
		(0.063)**
$\widehat{\alpha}_{rich}$		0.696
		(0.043)**

Notes: This table reports results from two alternative specifications of the production function from our structural model. The number of observations is 1447 and all specifications include country and year fixed effects whose estimates are omitted for brevity. Column (1) reports estimates where we allow for heterogeneous capital shares in the 1990s and the 2000s. In column (2) we allow for heterogeneous capital shares for poor and rich countries. Rich countries are defined as those with income above the median income in each year of our sample. Robust standard errors in parentheses. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table A3: Evaluation of NAFTA: Robustness Checks, Welfare Effects for the "Full Dynamic GE, trans." scenario

(1) Country	(2) Base-line	(3) Linear trans.	(4) Capital accum.	(5) Inter-mediates	(6) Ctry-specific δ δ	(7) Ctry-specific δ Welfare	(8) $\sigma =$ 11.282	(9) $\alpha =$ 0.3	(10) $\beta =$ 0.95	(11) $\rho =$ 2
AGO	-0.079	-0.076	-0.012	-0.084	0.042	-0.074	-0.044	-0.068	-0.067	-0.082
ARG	-0.016	-0.016	-0.010	-0.017	0.057	-0.016	-0.009	-0.014	-0.014	-0.017
AUS	-0.018	-0.017	-0.001	-0.019	0.058	-0.017	-0.010	-0.015	-0.015	-0.018
AUT	-0.013	-0.012	-0.005	-0.014	0.065	-0.013	-0.007	-0.011	-0.011	-0.013
AZE	-0.013	-0.013	-0.006	-0.014	0.041	-0.012	-0.007	-0.011	-0.011	-0.014
BEL	-0.027	-0.026	-0.006	-0.029	0.071	-0.028	-0.015	-0.023	-0.023	-0.028
BGD	-0.008	-0.007	-0.003	-0.008	0.037	-0.007	-0.004	-0.006	-0.006	-0.008
BGR	-0.003	-0.003	-0.002	-0.003	0.059	-0.003	-0.002	-0.003	-0.003	-0.003
BLR	-0.001	-0.001	0.000	-0.001	0.056	-0.001	-0.001	-0.001	-0.001	-0.001
BRA	-0.016	-0.015	-0.009	-0.017	0.062	-0.016	-0.008	-0.013	-0.013	-0.016
CAN	9.572	9.545	10.143	10.666	0.077	10.153	4.453	7.254	7.570	9.797
CHE	-0.038	-0.037	-0.020	-0.040	0.076	-0.039	-0.022	-0.033	-0.033	-0.040
CHL	-0.064	-0.062	-0.037	-0.068	0.043	-0.061	-0.036	-0.055	-0.055	-0.067
CHN	-0.020	-0.019	-0.007	-0.021	0.010	-0.014	-0.011	-0.017	-0.017	-0.021
COL	-0.036	-0.035	-0.021	-0.039	0.048	-0.035	-0.020	-0.031	-0.031	-0.038
CZE	-0.005	-0.005	-0.002	-0.005	0.054	-0.005	-0.003	-0.004	-0.004	-0.005
DEU	-0.019	-0.018	-0.006	-0.020	0.061	-0.019	-0.010	-0.016	-0.016	-0.019
DNK	-0.016	-0.015	-0.007	-0.017	0.067	-0.016	-0.008	-0.013	-0.013	-0.016
DOM	-0.056	-0.054	0.014	-0.060	0.040	-0.052	-0.031	-0.048	-0.047	-0.058
ECU	-0.044	-0.042	-0.010	-0.047	0.047	-0.042	-0.024	-0.037	-0.037	-0.046
EGY	-0.006	-0.006	-0.001	-0.006	0.061	-0.006	-0.003	-0.005	-0.005	-0.006
ESP	-0.012	-0.011	-0.008	-0.013	0.058	-0.012	-0.006	-0.010	-0.010	-0.012
ETH	-0.002	-0.002	0.000	-0.002	0.045	-0.002	-0.001	-0.002	-0.002	-0.002
FIN	-0.020	-0.019	-0.010	-0.021	0.060	-0.020	-0.011	-0.017	-0.017	-0.021
FRA	-0.013	-0.012	-0.003	-0.014	0.075	-0.013	-0.007	-0.011	-0.011	-0.013
GBR	-0.023	-0.022	-0.009	-0.025	0.100	-0.025	-0.013	-0.020	-0.020	-0.024
GHA	-0.011	-0.010	-0.004	-0.011	0.055	-0.010	-0.006	-0.009	-0.009	-0.011
GRC	-0.003	-0.003	-0.001	-0.003	0.057	-0.003	-0.001	-0.002	-0.002	-0.003
GTM	-0.076	-0.073	-0.015	-0.081	0.086	-0.080	-0.042	-0.064	-0.064	-0.079
HKG	-0.030	-0.029	-0.001	-0.032	0.049	-0.028	-0.016	-0.025	-0.025	-0.031
HRV	-0.003	-0.003	0.000	-0.003	0.052	-0.003	-0.002	-0.003	-0.003	-0.003
HUN	-0.008	-0.007	-0.003	-0.008	0.067	-0.008	-0.004	-0.006	-0.006	-0.008
IDN	-0.007	-0.007	-0.002	-0.008	0.046	-0.007	-0.004	-0.006	-0.006	-0.008
IND	-0.005	-0.005	-0.002	-0.006	0.057	-0.005	-0.003	-0.004	-0.004	-0.005
IRL	-0.071	-0.068	0.003	-0.074	0.095	-0.075	-0.040	-0.062	-0.060	-0.074
IRN	-0.001	-0.001	-0.002	-0.001	0.062	-0.001	-0.001	-0.001	-0.001	-0.001
IRQ	-0.044	-0.043	-0.007	-0.047	0.073	-0.045	-0.024	-0.038	-0.037	-0.046
ISR	-0.078	-0.076	0.025	-0.083	0.052	-0.076	-0.043	-0.067	-0.066	-0.081
ITA	-0.010	-0.010	-0.004	-0.011	0.067	-0.010	-0.006	-0.009	-0.009	-0.011
JPN	-0.021	-0.020	-0.007	-0.023	0.072	-0.022	-0.012	-0.018	-0.018	-0.022
KAZ	-0.009	-0.009	-0.006	-0.010	0.054	-0.009	-0.005	-0.008	-0.008	-0.009
KEN	-0.003	-0.003	0.000	-0.003	0.065	-0.003	-0.002	-0.003	-0.003	-0.003
KOR	-0.041	-0.040	-0.020	-0.044	0.038	-0.038	-0.023	-0.035	-0.035	-0.043
KWT	-0.014	-0.013	0.004	-0.015	0.043	-0.013	-0.007	-0.012	-0.011	-0.014
LBN	-0.009	-0.009	0.002	-0.010	0.034	-0.008	-0.005	-0.008	-0.008	-0.010
LKA	-0.011	-0.011	-0.003	-0.012	0.045	-0.010	-0.006	-0.009	-0.009	-0.011
LTU	-0.014	-0.013	-0.009	-0.015	0.065	-0.014	-0.008	-0.012	-0.012	-0.014
MAR	-0.009	-0.009	-0.002	-0.010	0.045	-0.009	-0.005	-0.008	-0.008	-0.009
MEX	5.748	5.740	6.086	6.418	0.080	6.138	2.687	4.369	4.538	5.880
MYS	-0.074	-0.071	-0.025	-0.078	0.034	-0.067	-0.042	-0.064	-0.063	-0.077
NGA	-0.069	-0.066	0.012	-0.073	0.089	-0.072	-0.038	-0.059	-0.058	-0.071
NLD	-0.022	-0.021	-0.004	-0.023	0.081	-0.022	-0.012	-0.018	-0.018	-0.022
NOR	-0.084	-0.080	-0.077	-0.088	0.086	-0.089	-0.048	-0.073	-0.072	-0.088
NZL	-0.025	-0.024	-0.009	-0.027	0.070	-0.025	-0.014	-0.021	-0.021	-0.026
OMN	-0.012	-0.012	0.007	-0.013	0.042	-0.012	-0.007	-0.010	-0.010	-0.013
PAK	-0.005	-0.004	-0.001	-0.005	0.063	-0.005	-0.002	-0.004	-0.004	-0.005
PER	-0.062	-0.060	-0.037	-0.066	0.043	-0.059	-0.034	-0.053	-0.053	-0.065
PHL	-0.020	-0.019	-0.004	-0.021	0.051	-0.019	-0.011	-0.016	-0.016	-0.020
POL	-0.003	-0.003	-0.002	-0.003	0.068	-0.003	-0.002	-0.003	-0.003	-0.003
PRT	-0.007	-0.006	-0.003	-0.007	0.052	-0.006	-0.003	-0.005	-0.005	-0.007
QAT	-0.009	-0.009	0.000	-0.010	0.016	-0.007	-0.005	-0.007	-0.007	-0.009

Continued on next page

Table A3 – *Continued from previous page*

(1) Country	(2) Base-line	(3) Linear trans.	(4) Capital accum.	(5) Inter-mediates	(6) Ctry-specific δ: δ	(7) Ctry-specific δ: Welfare	(8) $\sigma =$ 11.282	(9) $\alpha =$ 0.3	(10) $\beta =$ 0.95	(11) $\rho =$ 2
ROM	-0.004	-0.004	-0.002	-0.004	0.061	-0.004	-0.002	-0.003	-0.003	-0.004
RUS	-0.003	-0.003	0.000	-0.004	0.072	-0.003	-0.002	-0.003	-0.003	-0.003
SAU	-0.025	-0.024	0.001	-0.027	0.057	-0.025	-0.014	-0.021	-0.021	-0.026
SDN	-0.005	-0.004	-0.005	-0.005	0.006	-0.003	-0.002	-0.004	-0.004	-0.005
SER	-0.002	-0.002	0.000	-0.002	0.057	-0.002	-0.001	-0.002	-0.002	-0.002
SGP	-0.092	-0.088	-0.006	-0.096	0.035	-0.084	-0.053	-0.081	-0.079	-0.096
SVK	-0.003	-0.003	-0.001	-0.003	0.057	-0.003	-0.001	-0.002	-0.002	-0.003
SWE	-0.021	-0.020	-0.006	-0.022	0.097	-0.022	-0.011	-0.017	-0.017	-0.021
SYR	-0.007	-0.007	-0.001	-0.007	0.047	-0.007	-0.004	-0.006	-0.006	-0.007
THA	-0.022	-0.021	-0.007	-0.023	0.046	-0.021	-0.012	-0.019	-0.018	-0.023
TKM	-0.001	-0.001	0.000	-0.001	0.036	-0.001	-0.001	-0.001	-0.001	-0.001
TUN	-0.003	-0.003	-0.001	-0.004	0.048	-0.003	-0.002	-0.003	-0.003	-0.004
TUR	-0.005	-0.005	-0.001	-0.006	0.088	-0.005	-0.003	-0.004	-0.004	-0.005
TZA	-0.003	-0.003	-0.002	-0.003	0.048	-0.003	-0.002	-0.003	-0.003	-0.003
UKR	-0.003	-0.003	-0.001	-0.003	0.054	-0.003	-0.001	-0.002	-0.002	-0.003
USA	1.031	1.037	5.113	1.163	0.091	1.125	0.483	0.789	0.804	1.052
UZB	-0.001	-0.001	0.000	-0.001	0.078	-0.001	0.000	-0.001	-0.001	-0.001
VEN	-0.059	-0.056	-0.008	-0.062	0.067	-0.059	-0.032	-0.050	-0.049	-0.061
VNM	-0.016	-0.016	-0.004	-0.017	0.008	-0.011	-0.009	-0.014	-0.014	-0.017
ZAF	-0.012	-0.012	-0.002	-0.013	0.081	-0.013	-0.007	-0.010	-0.010	-0.013
ZWE	-0.001	-0.001	0.000	-0.001	0.061	-0.001	-0.001	-0.001	-0.001	-0.001
World	0.562	0.564	1.553	0.631		0.606	0.262	0.427	0.441	0.575
NAFTA	2.056	2.059	5.566	2.304		2.211	0.961	1.565	1.616	2.101
ROW	-0.018	-0.017	-0.006	-0.019		-0.017	-0.010	-0.015	-0.015	-0.018

Notes: This table reports robustness results for our NAFTA counterfactual. It is based on observed data on labor endowments and GDPs for our sample of 82 countries. Further, it uses our estimated trade costs based on equation (30) and recovered theory-consistent, steady-state capital stocks according to the capital accumulation equation (25). We calculate baseline preference-adjusted technology A_j/γ_j according to the market-clearing equation (23) and the production function equation (24). Finally, the counterfactual is based on our own estimates of the elasticity of substitution $\widehat{\sigma} = 5.847$, the share of capital in the Cobb-Douglas production function $\widehat{\alpha} = 0.545$, and the capital depreciation rate $\widehat{\delta} = 0.061$. The consumers' discount factor β is set equal to 0.98. Only welfare effects for the "Full Dynamic GE, trans." scenario are reported. Column (1) lists the country abbreviations. Columns (2) reports for reasons of comparison the results from our baseline setting reported in column (5) in Table 5. Column (3) is based on the linear instead of the log-linear capital transition function. Column (4) assumes a 20% higher capital stock in U.S. in 1994 when NAFTA was concluded. Column (5) reports results that allow for intermediate inputs. Column (6) lists the estimated country-specific depreciation rates δ_i, while column (7) reports the corresponding welfare effects of NAFTA based on these depreciation rates. Column (8) is based on an elasticity of substitution of $\widehat{\sigma} = 11.282$ instead of 5.847. Column (9) reports results based on a capital share of $\widehat{\alpha} = 0.3$, a standard value from the literature, instead of 0.545. Column (10) changes the subjective discount factor from 0.98 to 0.95, while the last column changes the intertemporal elasticity of substitution from one (implied by our logarithmic utility function for instantaneous utility) to 0.5 ($=1/\rho$) using an iso-elastic utility function for instantaneous utility.

D Growth and Trade in the Long-Run

The long-run effects of trade openness on growth are captured by the comparative statics of the steady states. Equation (25) defines steady-state capital:

$$K_j = \Omega_j = \frac{\alpha\beta\delta\phi_j Y_j}{(1-\beta+\beta\delta)P_j}, \tag{A32}$$

Substitute for the factory-gate price $p_{j,t}$ in the *Income equation* (24) using the factory-gate price equation (23) and solve for Y_j:

$$Y_j = \left(\frac{A_j L_j^{1-\alpha} K_j^{\alpha}}{Y^{\frac{1}{1-\sigma}} \gamma_j \Pi_j}\right)^{\frac{\sigma-1}{\sigma}}.$$

Use this expression to replace Y_j in the steady-state capital expression (A32):

$$K_j = \frac{\alpha\beta\delta\phi_j}{(1-\beta+\beta\delta)\,P_j}\left(\frac{A_j L_j^{1-\alpha} K_j^{\alpha}}{Y^{\frac{1}{1-\sigma}} \gamma_j \Pi_j}\right)^{\frac{\sigma-1}{\sigma}}.$$

Solve for K_j:

$$\begin{aligned} K_j &= \left[\frac{\alpha\beta\delta\phi_j}{(1-\beta+\beta\delta)\,P_j}\left(\frac{A_j L_j^{1-\alpha}}{Y^{\frac{1}{1-\sigma}} \gamma_j \Pi_j}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma(1-\alpha)+\alpha}} \\ &= \left(\frac{\alpha\beta\delta\phi_j}{(1-\beta+\beta\delta)\,P_j}\right)^{\frac{\sigma}{\sigma(1-\alpha)+\alpha}}\left(\frac{A_j L_j^{1-\alpha}}{Y^{\frac{1}{1-\sigma}} \gamma_j \Pi_j}\right)^{\frac{\sigma-1}{\sigma(1-\alpha)+\alpha}}. \end{aligned}$$

Define the relative change in variable X as $\widehat{X} \equiv X'/X$, where X' is evaluated at some other point on the real line than X. Taking A_j, L_j and parameters as given, the ratio of steady-state capital stocks is:

$$\widehat{K}_j = \widehat{P}_j^{\frac{-\sigma}{\sigma(1-\alpha)+\alpha}}\,\widehat{\Pi}_j^{\frac{1-\sigma}{\sigma(1-\alpha)+\alpha}}\,\widehat{Y}^{\frac{1}{\sigma(1-\alpha)+\alpha}}. \tag{A33}$$

Equation (A33) captures several intuitive relationships. First, if P_j increases, capital accumulation becomes more expensive and decreases capital because P_j captures the price of investment as well as consumption. Second, increases in sellers' incidence Π_j reduce capital stock K_j. Π_j affects p_j inversely, so the value marginal product of capital falls with Π_j, decreasing the incentive to accumulate capital. Third, as the world gets richer, measured by an increase of world GDP ($\widehat{Y}$), capital accumulation in j increases to efficiently serve the larger world market.

E ACR Formula

This section obtains the ACR-equivalent formula in our dynamic setting. Before we start, we note that real income and welfare coincide in the original ACR formula, however, this is no longer the case in our framework where not all of the income is used for consumption because part of it is used to build up capital. Accordingly, our welfare measure should be based on consumption. In order to derive an ACR equivalent, we start with consumption, as given by equation (A11), and we use the production function $Y_{j,t} = p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha}$ to express welfare as:

$$W_{j,t} \equiv C_{j,t} = \left(\frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta} \right) \frac{\phi_{j,t} Y_{j,t}}{P_{j,t}}.$$

Take log-derivative:[67]

$$d\ln W_{j,t} = d\ln Y_{j,t} - d\ln P_{j,t}.$$

Take $A_{j,t}$ and $L_{j,t}$ as given, and express $d\ln Y_{j,t}$ as:

$$d\ln Y_{j,t} = d\ln p_{j,t} + \alpha d\ln K_{j,t}. \tag{A34}$$

Use the definition of $P_{j,t}$:

$$P_{j,t} = \left[\sum_{i=1}^{N} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.$$

Differentiate:

$$\begin{aligned} d\ln P_{j,t} &= \frac{1}{P_{j,t}} dP_{j,t}, \\ &= \frac{1}{P_{j,t}} \frac{1}{1-\sigma} \left[\sum_{i=1}^{N} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}-1} \\ &\quad \times \sum_{i=1}^{N} \left((1-\sigma) \gamma_i^{1-\sigma} p_{i,t}^{-\sigma} t_{ij,t}^{1-\sigma} dp_{i,t} + (1-\sigma) \gamma_i^{1-\sigma} p_{i,t}^{1-\sigma} t_{ij,t}^{-\sigma} dt_{ij,t} \right) \\ &= \left[\sum_{i=1}^{N} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{1-\sigma} \right]^{-\frac{1}{1-\sigma}} \left[\sum_{i=1}^{N} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}-1} \\ &\quad \times \sum_{i=1}^{N} \left(\gamma_i^{1-\sigma} p_{i,t}^{-\sigma} t_{ij,t}^{1-\sigma} dp_{i,t} + \gamma_i^{1-\sigma} p_{i,t}^{1-\sigma} t_{ij,t}^{-\sigma} dt_{ij,t} \right) \end{aligned}$$

[67] Note that all parameters do not change between baseline and any counterfactual analysis.

$$
\begin{aligned}
&= P_{j,t}^{-(1-\sigma)} \sum_{i=1}^{N} \left(\gamma_i^{1-\sigma} p_{i,t}^{-\sigma} t_{ij,t}^{1-\sigma} dp_{i,t} + \gamma_i^{1-\sigma} p_{i,t}^{1-\sigma} t_{ij,t}^{-\sigma} dt_{ij,t} \right) \\
&= \sum_{i=1}^{N} \left(\left(\frac{\gamma_i p_{i,t} t_{ij,t}}{P_{j,t}} \right)^{1-\sigma} d\ln p_{i,t} + \left(\frac{\gamma_i p_{i,t} t_{ij,t}}{P_{j,t}} \right)^{1-\sigma} d\ln t_{ij,t} \right).
\end{aligned}
$$

Use $X_{ij,t} = \left(\frac{\gamma_i p_{i,t} t_{ij,t}}{P_{j,t}} \right)^{1-\sigma} \phi_{j,t} Y_{j,t}$ and define $\lambda_{ij,t} = X_{ij,t} / \left(\phi_{j,t} Y_{j,t} \right) = \left(\frac{\gamma_i p_{i,t} t_{ij,t}}{P_{j,t}} \right)^{1-\sigma}$:

$$
d\ln P_{j,t} = \sum_{i=1}^{N} \lambda_{ij,t} \left(d\ln p_{i,t} + d\ln t_{ij,t} \right). \tag{A35}
$$

Combine terms:

$$
d\ln W_{j,t} = d\ln Y_{j,t} - d\ln P_{j,t} = d\ln p_{j,t} + \alpha d\ln K_{j,t} - \sum_{i=1}^{N} \lambda_{ij,t} \left(d\ln p_{i,t} + d\ln t_{ij,t} \right).
$$

Take the ratio of $\lambda_{ij,t}$ and $\lambda_{jj,t}$:

$$
\frac{\lambda_{ij,t}}{\lambda_{jj,t}} = \left(\frac{\gamma_i p_{i,t} t_{ij,t}}{\gamma_j p_{j,t} t_{jj,t}} \right)^{1-\sigma}.
$$

Consider a foreign shock that leaves the ability to serve the own market, $t_{jj,t}$, unchanged as in ACR. The change of this ratio is given by:

$$
\begin{aligned}
d\left(\frac{\lambda_{ij,t}}{\lambda_{jj,t}} \right) &= \frac{1-\sigma}{\left(\gamma_j p_{j,t} t_{jj,t} \right)^{1-\sigma}} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{-\sigma} \left(\gamma_i p_{i,t} dt_{ij,t} + \gamma_i t_{ij,t} dp_{i,t} \right) \\
&\quad - \frac{1-\sigma}{\left(\gamma_j p_{j,t} t_{jj,t} \right)^{2-\sigma}} \left(\gamma_i p_{i,t} t_{ij,t} \right)^{1-\sigma} \gamma_j t_{jj,t} dp_{j,t}.
\end{aligned}
$$

Express as log-change:

$$
\frac{d\left(\frac{\lambda_{ij,t}}{\lambda_{jj,t}} \right)}{\frac{\lambda_{ij,t}}{\lambda_{jj,t}}} = d\ln \left(\frac{\lambda_{ij,t}}{\lambda_{jj,t}} \right) = d\ln \lambda_{ij,t} - d\ln \lambda_{jj,t} = (1-\sigma) \left(d\ln t_{ij,t} + d\ln p_{i,t} - d\ln p_{j,t} \right).
$$

Use this expression in equation (A35):

$$
\begin{aligned}
d\ln P_{j,t} &= \sum_{i=1}^{N} \lambda_{ij,t} \left(d\ln p_{i,t} + d\ln t_{ij,t} \right) \\
&= \sum_{i=1}^{N} \lambda_{ij,t} \left(\frac{1}{1-\sigma} \left(d\ln \lambda_{ij,t} - d\ln \lambda_{jj,t} \right) + d\ln p_{j,t} \right) \\
&= \frac{1}{1-\sigma} \left(\sum_{i=1}^{N} \lambda_{ij,t} d\ln \lambda_{ij,t} - d\ln \lambda_{jj,t} \sum_{i=1}^{N} \lambda_{ij,t} \right) + d\ln p_{j,t} \sum_{i=1}^{N} \lambda_{ij,t}.
\end{aligned}
$$

Express total expenditure as $\phi_{j,t}Y_{j,t} = \sum_{i=1}^{N} X_{ij,t}$. Hence, $\sum_{i=1}^{N} \lambda_{ij,t} = 1$ and $d\sum_{i=1}^{N} \lambda_{ij,t} = \sum_{i=1}^{N} d\lambda_{ij,t} = 0$. Further, $\sum_{i=1}^{N} \lambda_{ij,t} d\ln\lambda_{ij,t} = \sum_{i=1}^{N} d\lambda_{ij,t} = 0$. Use these relationships to simplify the above expression:

$$\begin{aligned} d\ln P_{j,t} &= \frac{1}{1-\sigma}\left(\sum_{i=1}^{N} \lambda_{ij,t} d\ln\lambda_{ij,t} - d\ln\lambda_{jj,t}\sum_{i=1}^{N}\lambda_{ij,t}\right) + d\ln p_{j,t} \\ &= -\frac{1}{1-\sigma} d\ln\lambda_{jj,t} + d\ln p_{j,t}. \end{aligned} \tag{A36}$$

Substitute this relationship in the welfare change expression:

$$\begin{aligned} d\ln W_{j,t} &= d\ln Y_{j,t} - d\ln P_{j,t} = d\ln p_{j,t} + \alpha d\ln K_{j,t} + \frac{1}{1-\sigma} d\ln\lambda_{jj,t} - d\ln p_{j,t} \\ &= \alpha d\ln K_{j,t} + \frac{1}{1-\sigma} d\ln\lambda_{jj,t}. \end{aligned}$$

Integrate between a <u>b</u>aseline situation and a <u>c</u>ounterfactual scenario:

$$\begin{aligned} \int_{W_{j,t}^b}^{W_{j,t}^c} d\ln W_{j,t} &= \int_{K_{j,t}^b}^{K_{j,t}^c} \alpha d\ln K_{j,t} + \int_{\lambda_{jj,t}^b}^{\lambda_{jj,t}^c} \frac{1}{1-\sigma} d\ln\lambda_{jj,t}, \\ \left(\ln W_{j,t} + C_1\right)\Big|_{W_{j,t}^b}^{W_{j,t}^c} &= \left(\alpha\ln K_{j,t} + C_2\right)\Big|_{K_{j,t}^b}^{K_{j,t}^c} + \left(\frac{1}{1-\sigma}\ln\lambda_{jj,t} + C_3\right)\Bigg|_{\lambda_{jj,t}^b}^{\lambda_{jj,t}^c}, \\ \ln W_{j,t}^c + C_1 - \ln W_{j,t}^b - C_1 &= \alpha\ln K_{j,t}^c + C_2 - \alpha\ln K_{j,t}^b - C_2 + \frac{1}{1-\sigma}\ln\lambda_{jj,t}^c + C_3 \\ &\quad -\frac{1}{1-\sigma}\ln\lambda_{jj,t}^b - C_3. \end{aligned}$$

Use "hat" to denote the ratio of any counterfactual to baseline value of a variable, i.e., $\widehat{X} = X^c/X^b$:

$$\ln\widehat{W_{j,t}} = \alpha\ln\widehat{K}_{j,t} + \frac{1}{1-\sigma}\ln\widehat{\lambda}_{jj,t}.$$

Take the exponent on the left- and right-hand side:

$$\widehat{W_{j,t}} = \widehat{K}_{j,t}^{\alpha}\widehat{\lambda}_{jj,t}^{\frac{1}{1-\sigma}}. \tag{A37}$$

Note that this welfare expression holds in and out-of steady state.

E.1 ACR Formula in Steady State

Start by recovering theory-consistent, steady-state capital stocks from the capital accumulation equation (25), and use expression (24) to replace Y_j:

$$K_j = \frac{\alpha\beta\delta\phi_j p_j A_j L_j^{1-\alpha} K_j^{\alpha}}{(1-\beta+\beta\delta)\, P_j}.$$

Solve for K_j:

$$K_j \quad = \quad \left[\frac{\alpha\beta\delta\phi_j p_j A_j L_j^{1-\alpha}}{(1-\beta+\beta\delta)\,P_j}\right]^{\frac{1}{(1-\alpha)}}.$$

To calculate the change in K_j, first take log-derivatives:

$$d\ln K_j = \frac{1}{1-\alpha}\left(d\ln p_j - d\ln P_j\right).$$

Replace $d\ln P_j$ by $-\frac{1}{1-\sigma}d\ln\lambda_{jj} + d\ln p_j$:

$$d\ln K_j = \frac{1}{(1-\alpha)}\frac{1}{(1-\sigma)}d\ln\lambda_{jj}.$$

Note that $d\ln p_j$ cancels out. Integrating both sides between the baseline and the counterfactual and denoting K^c/K^b with hats, where K^c and K^b denote the counterfactual and baseline values of K, respectively:

$$\ln\widehat{K}_j = \frac{1}{(1-\alpha)}\frac{1}{(1-\sigma)}\ln\widehat{\lambda}_{jj}.$$

Exponentiate:

$$\widehat{K}_j = \widehat{\lambda}_{jj}^{\frac{1}{(1-\alpha)(1-\sigma)}}.$$

Plug this expression into equation (A37):

$$\widehat{W_j} = \widehat{\lambda}_{jj}^{\frac{\alpha}{(1-\alpha)(1-\sigma)}}\widehat{\lambda}_{jj}^{\frac{1}{1-\sigma}} = \widehat{\lambda}_{jj}^{\frac{1}{(1-\alpha)(1-\sigma)}}.$$

Note that this expression is very similar to the ACR formula for intermediates with perfect competition, which also just adds the share of intermediates in production to the exponent (see page 115 in ACR). Thus, in steady state, capital accumulation acts pretty much the same as adding intermediates. The key difference between our setting and a model with intermediates is the dynamics and the transition path. We characterize the transition path in Section B, and we discuss the extension to allow for intermediates in Section C.5.

E.2 ACR Formula Out-of Steady State

In Subsection E.1 we assumed that we were in a steady state. In this section, we investigate the properties of our model with respect to ACR out of steady state. To do this, we go back to equation (A37), which holds in and out-of steady state:

$$\widehat{W_{j,t}} = \widehat{K}_{j,t}^{\alpha}\widehat{\lambda}_{jj,t}^{\frac{1}{1-\sigma}}.$$

Starting with this expression, we have to determine $\widehat{K}_{j,t}$. Take the capital equation as given by equation (25) and replace $p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{1-\alpha}$ by $Y_{j,t}$:

$$K_{j,t+1} = \left[\frac{\beta\alpha\delta\phi_{j,t}Y_{j,t}}{(1-\beta+\delta\beta)\,P_{j,t}}\right]^{\delta} K_{j,t}^{1-\delta}.$$

Write this equation in log-derivatives:

$$d\ln K_{j,t+1} = \delta(d\ln Y_{j,t} - d\ln P_{j,t}) + (1-\delta)d\ln K_{j,t}.$$

Use equation (A34),

$$d\ln Y_{j,t} = d\ln p_{j,t} + \alpha d\ln K_{j,t},$$

and equation (A36),

$$d\ln P_{j,t} = -\frac{1}{1-\sigma}d\ln\lambda_{jj,t} + d\ln p_{j,t},$$

to obtain:

$$\begin{aligned} d\ln K_{j,t+1} &= \delta(\alpha d\ln K_{j,t} + \frac{1}{1-\sigma}d\ln\lambda_{jj,t}) + (1-\delta)d\ln K_{j,t} \Rightarrow \\ d\ln K_{j,t+1} &= \frac{1}{1-\sigma}d\ln\lambda_{jj,t} + (1-\delta(1-\alpha))d\ln K_{j,t}. \end{aligned}$$

Integrate between a <u>b</u>aseline situation and a <u>c</u>ounterfactual situation:

$$\begin{aligned} \int_{K_{j,t+1}^{b}}^{K_{j,t+1}^{c}} d\ln K_{j,t+1} &= \int_{\lambda_{jj,t}^{b}}^{\lambda_{jj,t}^{c}} \frac{1}{1-\sigma}d\ln\lambda_{jj,t} + \int_{K_{j,t}^{b}}^{K_{j,t}^{c}}(1-\delta(1-\alpha))d\ln K_{j,t}, \\ (\ln K_{j,t+1}+C_1)\Big|_{K_{j,t+1}^{b}}^{K_{j,t+1}^{c}} &= \left(\frac{1}{1-\sigma}\ln\lambda_{jj,t}+C_2\right)\Bigg|_{\lambda_{jj,t}^{b}}^{\lambda_{jj,t}^{c}} \\ &\quad + ((1-\delta(1-\alpha))\ln K_{j,t}+C_3)\Big|_{K_{j,t}^{b}}^{K_{j,t}^{c}}, \\ \ln K_{j,t+1}^{c} + C_1 - \ln K_{j,t+1}^{b} - C_1 &= \frac{1}{1-\sigma}\ln\lambda_{jj,t}^{c} + C_2 - \frac{1}{1-\sigma}\ln\lambda_{jj,t}^{b} - C_2 \\ &\quad +\big((1-\delta(1-\alpha))\ln K_{j,t}^{c} + C_3 \\ &\quad -(1-\delta(1-\alpha))\ln K_{j,t}^{b} - C_3\big). \end{aligned}$$

Use "hat" to denote the ratio of any counterfactual and baseline value of a given variable, i.e., $\widehat{X} = X^c/X^b$:

$$\ln\widehat{K}_{j,t+1} = \frac{1}{1-\sigma}\ln\widehat{\lambda}_{jj,t} + (1-\delta(1-\alpha))\ln\widehat{K}_{j,t}.$$

Exponentiate:

$$\widehat{K}_{j,t+1} = \widehat{K}_{j,t}^{1-\delta(1-\alpha)}\widehat{\lambda}_{jj,t}^{\frac{1}{1-\sigma}}.$$

Use $\widehat{W}_{j,t} = \widehat{K}^{\alpha}_{j,t}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,t}$ and note that in period zero $\widehat{K}_{j,0} = 1$. Express welfare as an iterative formula which only depends on $\widehat{\lambda}_{jj,t}$ and changes of the capital stock:

$$\begin{aligned}
\widehat{W}_{j,t} &= \widehat{K}^{\alpha}_{j,t}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,t}, \\
\widehat{K}_{j,t+1} &= \widehat{K}^{1-\delta(1-\alpha)}_{j,t}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,t}, \\
\widehat{K}_{j,0} &= 1.
\end{aligned}$$

To show that welfare can be expressed as a function of $\widehat{\lambda}_{jj,t}$ and parameters alone, we iteratively plug in $\widehat{K}_{j,t+1}$. In period 0:

$$\begin{aligned}
\widehat{W}_{j,0} &= \widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,0}, \\
\widehat{K}_{j,1} &= \widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,0}.
\end{aligned}$$

In period 1:

$$\begin{aligned}
\widehat{W}_{j,1} &= \widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,0}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,1}, \\
\widehat{K}_{j,2} &= \widehat{\lambda}^{\frac{1-\delta(1-\alpha)}{1-\sigma}}_{jj,0}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,1}.
\end{aligned}$$

In period 2:

$$\begin{aligned}
\widehat{W}_{j,2} &= \widehat{\lambda}^{\frac{1-\delta(1-\alpha)}{1-\sigma}}_{jj,0}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,1}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,2}, \\
\widehat{K}_{j,3} &= \widehat{\lambda}^{\frac{(1-\delta(1-\alpha))^2}{1-\sigma}}_{jj,0}\widehat{\lambda}^{\frac{1-\delta(1-\alpha)}{1-\sigma}}_{jj,1}\widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,2}. \\
&....
\end{aligned}$$

Finally, in period T:

$$\begin{aligned}
\widehat{W}_{j,T} &= \widehat{\lambda}^{\frac{1}{1-\sigma}}_{jj,T}\prod_{t=0}^{T-1}\widehat{\lambda}^{\frac{(1-\delta(1-\alpha))^{T-1-t}}{1-\sigma}}_{jj,t}, \\
\widehat{K}_{j,T+1} &= \prod_{t=0}^{T}\widehat{\lambda}^{\frac{(1-\delta(1-\alpha))^{T-t}}{1-\sigma}}_{jj,t},
\end{aligned}$$

which are both functions of $\widehat{\lambda}_{jj,t}$ and parameters only. So far the out-of steady state formulae give welfare without taking discounting into account. Note that $\widehat{W}_{j,t} = \widehat{C}_{j,t}$. Hence, we can calculate welfare with discounting by using equation (27):

$$\begin{aligned}\zeta &= \left(\exp\left[(1-\beta)\left(\sum_{t=0}^{\infty}\beta^t \ln\left(C_{j,t}^c\right) - \sum_{t=0}^{\infty}\beta^t \ln\left(C_{j,t}^b\right)\right)\right] - 1\right) \times 100 \\ &= \left(\exp\left[(1-\beta)\left(\sum_{t=0}^{\infty}\beta^t \ln\left(\widehat{C}_{j,t}\right)\right)\right] - 1\right) \times 100 \\ &= \left(\exp\left[(1-\beta)\left(\sum_{t=0}^{\infty}\beta^t \ln\left(\widehat{K}_{j,t}^{\alpha}\widehat{\lambda}_{jj,t}^{\frac{1}{1-\sigma}}\right)\right)\right] - 1\right) \times 100. \end{aligned} \tag{A38}$$

Thus, we have demonstrated that, in principle, out-of steady state, welfare can also be expressed as a function of the changes in $\lambda_{jj,t}$. However, we have to trace the change of $\lambda_{jj,t}$ only driven by the counterfactual change over the transition. As we will typically not be able to observe these changes, this expression is more for gaining theoretical insights into the working of the system than for practical use.

F Details to Trade Cost Estimates

As discussed in the main text, our strategy to measure bilateral trade costs has been to use the estimates of the country-pair fixed effects $\widehat{\mu}_{ij}$ from equation (28) directly. However, due to missing (or zero) trade flows, we cannot identify the complete set of bilateral fixed effects. Fortunately, our data (due to its aggregate nature) enabled us to obtain estimates of the bilateral fixed effects for all but seven pairs including Angola-Iraq, Angola-Turkmenistan, Angola-Uzbekistan, Iraq-Uzbekistan, Ghana-Turkmenistan, Qatar-Uzbekistan, and Turkmenistan-Venezuela. In robustness analysis we reproduce our results treating trade costs between the pairs as missing, and we find virtually identical results. Nevertheless, to obtain the main results in the paper, we decided to recover the bilateral trade costs for the seven missing pairs. In order to do this, we adopt a procedure similar to the one from Anderson and Yotov (2016) who propose a two-step method to construct bilateral trade costs, while accounting for RTA endogeneity with country-pair fixed effects. Applied to our setting, the first step of the Anderson-Yotov procedure obtains estimates of the country-pair fixed effects μ_{ij} from equation (28). Then, in the second stage, the estimates of the bilateral fixed effects are regressed on the set of standard gravity variables:

$$\exp\left(\widehat{\mu}_{ij}\right) = \exp\left[\sum_{m=2}^{5} \tilde{\eta}_m \ln DIST_{ij,m-1} + \tilde{\eta}_6 BRDR_{ij} + \tilde{\eta}_7 LANG_{ij} + \tilde{\eta}_8 CLNY_{ij} + \tilde{\chi}_i + \tilde{\pi}_j\right] + \varepsilon_{ij,t}, \tag{A39}$$

where $\ln DIST_{ij,m-1}$ is the logarithm of bilateral distance between trading partners i and j. We follow Eaton and Kortum (2002) to decompose the distance effects into four intervals, $m \in \{2, 3, 4, 5\}$. The distance intervals, in kilometers, are: [0, 3000); [3000, 7000); [7000, 10000); [10000, maximum]. Unlike Eaton and Kortum (2002) however, we do not only use indicator variables for each distance interval but instead, following Anderson and Yotov (2016), we interact the interval indicator variables with actual distances. This will enable us to account for further variation in trade costs within each distance interval. $BRDR_{ij}$ captures the presence of a contiguous border between partners i and j. $LANG_{ij}$ and $CLNY_{ij}$ account for common language and colonial ties, respectively. $\varepsilon_{ij,t}$ is a standard remainder error. As described in Agnosteva et al. (2014), the exporter and importer fixed effects, $\tilde{\chi}_i$ and $\tilde{\pi}_j$, are included in equation (A39) to account for the fact that the bilateral fixed effects from specification (28) are estimated relative to intra-national trade costs.

The estimates of bilateral trade costs that we obtain from equation (A39) are used to complete the matrix of bilateral trade costs where bilateral fixed effects are missing. For brevity, we report the estimates directly in the estimating equation:

$$\begin{aligned} \exp\left(\widehat{\mu}_{ij}\right) = {} & \exp[-\underset{(0.083)}{\mathbf{0.487}} \ln DIST_{ij,1} - \underset{(0.072)}{\mathbf{0.504}} \ln DIST_{ij,2} - \underset{(0.067)}{\mathbf{0.521}} \ln DIST_{ij,3} - \underset{(0.064)}{\mathbf{0.523}} \ln DIST_{ij,4}] \\ & \times \exp[\underset{(0.107)}{\mathbf{0.441}}\, BRDR_{ij} + \underset{(0.097)}{\mathbf{0.102}}\, LANG_{ij} + \underset{(0.125)}{\mathbf{0.487}}\, CLNY_{ij}], \end{aligned} \tag{A40}$$

where the coefficient estimates are reported in bold-face in front of the variables, and the corresponding robust standard errors, clustered by country pair, are in parentheses below them. All coefficient estimates of equation (A40) have the expected signs and reasonable magnitudes. Distance strongly impedes trade with precisely estimated elasticity around -0.5 in all intervals. (Our distance elasticity is about $1/2$ the representative value reported by Head and Mayer (2014), due to our different methods.) Contiguous borders promote international trade. The estimate on $BRDR$ is positive, large, statistically significant and comparable to estimates from the existing literature. Our estimate of the effect of language on bilateral trade is positive, as expected, but it is relatively small and not statistically significant. Finally, the estimate of the coefficient on $CLNY$ is large, positive and statistically significant as found in most of the literature.

Overall, we view the gravity estimates from equation (A40) to be plausible, and we are comfortable using them together with data on the gravity variables to construct the missing observations from the set of bilateral trade costs. These in turn are used to construct the multilateral resistance terms for the *Income* and *Capital* regressions that we estimate below, and also to perform our counterfactual experiments. We remind the reader that: (i) We only construct 7 missing values for bilateral trade costs; and (ii) Results obtained with and without recovering the missing seven observations are virtually identical.

G Country List and Country Labels

Our sample consists of the 82 countries. The list of countries and their respective labels in parentheses includes: Angola (AGO), Argentina (ARG), Australia (AUS), Austria (AUT), Azerbaijan (AZE), Bangladesh (BGD), Belarus (BLR), Belgium (BEL), Brazil (BRA), Bulgaria (BGR), Canada (CAN), Chile (CHL), China (CHN), Colombia (COL), Croatia (HRV), Czech Republic (CZE), Denmark (DNK), Dominican Republic (DOM), Ecuador (ECU), Egypt (EGY), Ethiopia (ETH), Finland (FIN), France (FRA), Germany (DEU), Ghana (GHA), Greece (GRC), Guatemala (GTM), Hong Kong (HKG), Hungary (HUN), India (IND), Indonesia (IDN), Iran (IRN), Iraq (IRQ), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Kazakhstan (KAZ), Kenya (KEN), Korea, Republic of (KOR), Kuwait (KWT), Lebanon (LBN), Lithuania (LTU), Malaysia (MYS), Mexico (MEX), Morocco (MAR), Netherlands (NLD), New Zealand (NZL), Nigeria (NGA), Norway (NOR), Oman (OMN), Pakistan (PAK), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Qatar (QAT), Romania (ROU), Russia (RUS), Saudi Arabia (SAU), Serbia (SRB), Singapore (SGP), Slovak Republic (SVK), South Africa (ZAF), Spain (ESP), Sri Lanka (LKA), Sudan (SDN), Sweden (SWE), Switzerland (CHE), Syria (SYR), Tanzania (TZA), Thailand (THA), Tunisia (TUN), Turkey (TUR), Turkmenistan (TKM), Ukraine (UKR), United Kingdom (GBR), United States (USA), Uzbekistan (UZB), Venezuela (VEN), Vietnam (VNM), and Zimbabwe (ZWE).

H The Growth-and-Trade System in Changes

In this section, we derive our system in changes using the 'exact hat' algebra as introduced by Dekle et al. (2007, 2008). In deriving the system in changes, the objective is to stick as close as possible to our original system (20)-(25), and specifically also keep the multilateral resistance terms. Doing so, however, shows that information about baseline trade costs is used when formulating the system in changes. Dekle et al. (2007, 2008) use observed trade flows to formulate the system in changes in terms of trade shares. In this case, only changes of trade costs, but not baseline levels of trade costs for solving the counterfactual values are necessary.

We first derive the system in changes out-of steady state followed by the system in changes in steady state. Denote baseline and counterfactual values with a superscript b and c, respectively, and define the change for variable X, as $\widehat{X} = X^c/X^b$. Start with the capital equation (25) and use the production function $Y_{j,t} = p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{1-\alpha}$:

$$K_{j,t+1} = \left[\frac{\beta\alpha\delta\phi_{j,t}Y_{j,t}}{(1-\beta+\delta\beta)\,P_{j,t}}\right]^{\delta} K_{j,t}^{1-\delta}.$$

This relationship holds in the baseline and in the counterfactual scenario. Therefore we can express it as a change:

$$\widehat{K}_{j,t+1} = \left[\frac{\widehat{Y}_{j,t}}{\widehat{P}_{j,t}}\right]^{\delta} \widehat{K}_{j,t}^{1-\delta}.$$

Use equation (23) to derive an expression for the changes of prices:

$$\widehat{p}_{j,t} = \frac{\left(\widehat{Y}_{j,t}/\widehat{Y}_t\right)^{\frac{1}{1-\sigma}}}{\widehat{\Pi}_{j,t}},$$

where,

$$\widehat{Y}_t = \frac{\sum_i Y_{i,t}^c}{\sum_i Y_{i,t}^b} \Rightarrow Y_t^b\widehat{Y}_t = \sum_i Y_{i,t}^b\widehat{Y}_{i,t}.$$

Use equation (22) to derive an equation for $\widehat{\Pi}_{j,t}$:

$$\left(\Pi_{i,t}^b\right)^{1-\sigma}\widehat{\Pi}_{i,t}^{1-\sigma} = \sum_j \left(\frac{t_{ij,t}^b\widehat{t}_{ij,t}}{P_{j,t}^b\widehat{P}_{j,t}}\right)^{1-\sigma}\frac{Y_{j,t}^b\widehat{Y}_{j,t}}{Y_t^b\widehat{Y}_t}.$$

Similarly, use equation (21) to describe the change in $P_{j,t}$:

$$\left(P_{j,t}^b\right)^{1-\sigma}\widehat{P}_{j,t}^{1-\sigma} = \sum_i \left(\frac{t_{ij,t}^b\widehat{t}_{ij,t}}{\Pi_{i,t}^b\widehat{\Pi}_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}^b\widehat{Y}_{i,t}}{Y_t^b\widehat{Y}_t}.$$

Assuming that technology and labor stay constant, use equation (24) to derive the change in GDP:

$$\widehat{Y}_{j,t} = \widehat{p}_{j,t} \widehat{K}_{j,t}^{\alpha}.$$

Collect equations to obtain the system of growth-and-trade in changes:

$$\begin{aligned}
\widehat{X}_{ij,t} &= \frac{\widehat{Y}_{i,t}\widehat{Y}_{j,t}}{\widehat{Y}_t} \left(\frac{\widehat{t}_{ij,t}}{\widehat{\Pi}_{i,t}\widehat{P}_{j,t}} \right)^{1-\sigma}, \\
\left(\Pi_{i,t}^b\right)^{1-\sigma} \widehat{\Pi}_{i,t}^{1-\sigma} &= \sum_j \left(\frac{t_{ij,t}^b \widehat{t}_{ij,t}}{P_{j,t}^b \widehat{P}_{j,t}} \right)^{1-\sigma} \frac{Y_{j,t}^b \widehat{Y}_{j,t}}{Y_t^b \widehat{Y}_t}, \\
\left(P_{j,t}^b\right)^{1-\sigma} \widehat{P}_{j,t}^{1-\sigma} &= \sum_i \left(\frac{t_{ij,t}^b \widehat{t}_{ij,t}}{\Pi_{i,t}^b \widehat{\Pi}_{i,t}} \right)^{1-\sigma} \frac{Y_{i,t}^b \widehat{Y}_{i,t}}{Y_t^b \widehat{Y}_t}, \\
\widehat{p}_{j,t} &= \frac{\left(\widehat{Y}_{j,t}/\widehat{Y}_t\right)^{\frac{1}{1-\sigma}}}{\widehat{\Pi}_{j,t}}, \\
Y_t^b \widehat{Y}_t &= \sum_i Y_{i,t}^b \widehat{Y}_{i,t}, \\
\widehat{Y}_{j,t} &= \widehat{p}_{j,t} \widehat{K}_{j,t}^{\alpha}, \\
\widehat{K}_{j,t+1} &= \left[\frac{\widehat{Y}_{j,t}}{\widehat{P}_{j,t}} \right]^{\delta} \widehat{K}_{j,t}^{1-\delta}.
\end{aligned}$$

This system needs only data on GDPs ($Y_{i,t}^b$) and trade costs ($t_{ij,t}^b$) in the baseline, and parameter values for α, σ and δ. Note that information on $A_{j,t}$, γ_j, and β is not needed. The changes in $t_{ij,t}$, $\widehat{t}_{ij,t}$, are exogenous, i.e., they form the basis of our counterfactual experiments, e.g., the basis for the evaluation of NAFTA. Further, with given GDPs and trade costs, we can solve for the baseline $\Pi_{i,t}^b$'s and $P_{j,t}^b$'s. Hence, we are left with seven equations for each t in the seven unknown changes $\widehat{X}_{ij,t}$, $\widehat{Y}_{i,t}$, $\widehat{Y}_t$, $\widehat{\Pi}_{i,t}$, $\widehat{P}_{j,t}$, $\widehat{p}_{j,t}$, $\widehat{K}_{j,t}$.

Note also that the capital equation in changes does not determine the level of capital. However, this is also not necessary. We merely have to note that $\widehat{K}_{j,0} = 1$, i.e., that there are no capital adjustments in the first iteration. Hence, we can write and solve our system in changes and solve for all counterfactual values of all endogenous variables with given $K_{j,0}$. We verified that the solutions that we obtain from our system in changes are identical to the solutions of our system in levels. This confirms that our reported changes from the system in levels are also invariant to the values of $A_{j,t}$, γ_j, and β. The reason is that they all enter multiplicative and are assumed to be constant between baseline and counterfactual. In addition, the equivalence of the results in levels and in changes is reassuring of the validity of our methods.

In steady state, the capital equation in changes simplifies to:

$$\widehat{K}_j = \left[\frac{\widehat{Y}_j}{\widehat{P}_j} \right]^{\delta} \widehat{K}_j^{1-\delta} \Rightarrow \widehat{K}_j = \frac{\widehat{Y}_j}{\widehat{P}_j}.$$

All other equations stay the same without time index.

I Counterfactual Procedure

The counterfactuals are performed in four steps.

Step 1: Obtain trade cost estimates by estimating equations (28) and (A39). Then calculate bilateral trade costs for the baseline setting:

$$\left(\widehat{t}_{ij,t}^{RTA}\right)^{1-\sigma} = \exp\left[\widehat{\eta}_1 RTA_{ij,t} + \hat{\mu}_{ij}\right]. \tag{A41}$$

For the counterfactual, additional trade costs may have to be calculated. For example, in the case of our NAFTA counterfactual, we set $RTA_{ij,t}$ to zero for the NAFTA countries after 1994, resulting in $RTA^c_{ij,t}$. Then we recalculate $\left(\widehat{t}_{ij,t}^{RTA}\right)^{1-\sigma}$ by replacing $RTA_{ij,t}$ with $RTA^c_{ij,t}$ in equation (A41). The differences between the values for the key variables of interest are obtained as a response to the change in the trade costs vector from $RTA_{ij,t}$ to $RTA^c_{ij,t}$.

Step 2: Using the estimates for trade costs described in Step 1, and estimates for the capital share $\widehat{\alpha}$, the elasticity of substitution $\widehat{\sigma}$, and the capital depreciation rate $\widehat{\delta}$ obtained from equations (32) and (34), a value for β taken from the literature, and data for $L_{j,t}$ and $Y_{j,t}$, and assuming that we are in a steady state in the baseline, i.e., $K_{j,t+1} = K_{j,t}$, we can calculate P_j using equations (21) and (22) and we can recover (from equation (25)) country-specific, theory-consistent steady-state capital stocks as follows:

$$K_j^{SS} = \frac{\alpha\beta\delta\phi_j Y_j}{\left(1 - \beta + \beta\delta\right) P_j}.$$

We use K_j^{SS} as our capital stock in period zero, i.e., $K_{j,0} = K_j^{SS}$.

We also recover preference-adjusted technology A_j/γ_j in the baseline setting by noting that the lower level can be solved without knowledge of A_j/γ_j, and then, using Π_j and combining (23) and (24), leading to:

$$\frac{A_j}{\gamma_j} = \frac{Y_j \Pi_j}{\left(Y_j/Y\right)^{\frac{1}{1-\sigma}} L_j^{1-\alpha} \left(K_j^{SS}\right)^{\alpha}}.$$

As we recover K_j^{SS} and A_j/γ_j from data and estimated parameters, we ensure that our baseline setting is perfectly consistent with our GDP and employment data.

Step 3: Using the values obtained in Steps 1 and 2, we solve our system given by equations (20)-(25) in the baseline and in the counterfactual starting from year 0 until convergence to the new steady state.

Step 4: After solving the model, we calculate the effects on trade, on the MRs, on welfare, and on capital accumulation. We report the results for all countries individually, as well as aggregates for the world, NAFTA, and the non-NAFTA countries (labeled "Rest Of the World", ROW).

Trade effects: Trade effects are calculated as percentage changes in overall exports for each country between the baseline and the counterfactual values:

$$\Delta X_{i,t}\% = \frac{\left(\sum_{j \neq i} X^c_{ij,t} - \sum_{j \neq i} X^b_{ij,t}\right)}{\sum_{j \neq i} X^b_{ij,t}} \times 100,$$

where $X_{ij,t}$ is calculated according to equation (20), and $X^b_{ij,t}$ and $X^c_{ij,t}$ are the baseline and counterfactual trade flows, respectively. Note that, in the case of NAFTA, we calculate the change of trade from the case without NAFTA to the case with NAFTA in place, as a share of trade in the case without NAFTA, even though we have to counterfactually solve for the case without NAFTA. The effects for the world as a whole are calculated by summing over all countries, i.e., $\Delta X_{\text{World},t}\% = \left(\sum_i \sum_{j \neq i} X^c_{ij,t} - \sum_i \sum_{j \neq i} X^b_{ij,t}\right) / \left(\sum_i \sum_{j \neq i} X^b_{ij,t}\right) \times 100$. For the trade effects within NAFTA, we only sum over the six within-NAFTA trade relationships (CAN-USA, CAN-MEX, MEX-CAN, MEX-USA, USA-CAN, USA-MEX). For ROW, we sum all remaining bilateral trade relationships.

MR effects: The MR effects are also calculated as the percentage change of $P_{i,t}$ and $\Pi_{i,t}$ for each country i and year t between the baseline and the counterfactual values, respectively. Note that we calculate the baseline assuming balanced trade (i.e., $\phi_{i,t} = 1$ for all i and t) and together with symmetric trade costs this implies $P_{i,t} = \Pi_{i,t}$. Hence, we only have to report one effect for every country in this case:

$$\Delta P_{i,t}\% = \frac{\left(P^c_{i,t} - P^b_{i,t}\right)}{P^b_{i,t}} \times 100,$$

where $P_{i,t}$ is calculated as given by equation (21), and $P^b_{i,t}$ and $P^c_{i,t}$ are the baseline and counterfactual values of the MRs. The effects for the world are calculated as simple means over the changes for all countries, i.e., $\Delta P_{\text{World},t} = 1/N \sum_i \Delta P_{i,t}\%$. For NAFTA, we only take the mean over the three NAFTA members, while the results for ROW are calculated as the mean over the remaining 79 countries.

Welfare effects: In the "Cond. GE" and in the "Full Static GE" cases, welfare is given by real GDP per capita.[68] Using equation (24), $Y_{i,t} = p_{i,t} A_{i,t} L^{1-\alpha}_{i,t} K^{\alpha}_{i,t}$, and equation (23), $(\gamma_i p_{i,t} \Pi_{i,t})^{1-\sigma} = Y_{i,t}/Y_t$, to replace $p_{i,t}$, we can express real GDP per capita as:

$$\tilde{Y}_{i,t} = \frac{Y_{i,t}}{P_{i,t} L_{i,t}} = \frac{p_{i,t} A_{i,t} L^{1-\alpha}_{i,t} K^{\alpha}_{i,t}}{P_{i,t} L_{i,t}} = \frac{(Y_{i,t}/Y_t)^{1/(1-\sigma)} A_{i,t} L^{-\alpha}_{i,t} K^{\alpha}_{i,t}}{\gamma_i \Pi_{i,t} P_{i,t}}.$$

This expression can be used to calculate baseline and counterfactual values of $\tilde{Y}_{i,t}$, i.e., $\tilde{Y}^b_{i,t}$

[68] Note that in our setting $P_{j,t}$ can also be interpreted as an ideal price index. $C_{j,t}/P_{j,t}$ therefore corresponds to indirect utility.

and $\tilde{Y}_{i,t}^{c}$. The change in welfare effects is then given by:

$$\Delta\tilde{Y}_{i,t}\% = \frac{\left(\tilde{Y}_{i,t}^{c} - \tilde{Y}_{i,t}^{b}\right)}{\tilde{Y}_{i,t}^{b}} \times 100.$$

Note that the change in real expenditure ($\Delta\tilde{E}_{i,t}\%$) is identical to $\Delta\tilde{Y}_{i,t}\%$, as we only consider exogenous trade imbalances.

In the "Full Dynamic GE, SS" and "Full Dynamic GE, trans." scenarios, welfare is calculated according to equation (27). The results for the world are calculated as weighted sums of the welfare effects over all countries. We use GDPs as weights. Hence, the reported world welfare effects are calculated as: $\Delta\tilde{Y}_{\text{World},t}\% = \sum_i \left(\Delta\tilde{Y}_{i,t}\% \times \frac{Y_{i,t}^{b}}{\sum_j Y_{j,t}^{b}}\right)$. For NAFTA, we only take the GPD weighted sum over the three NAFTA members, while the results for ROW are calculated as the GDP weighted sums over the remaining 79 countries.

Capital effects: The effects on capital are also calculated as the percentage changes between the baseline and the counterfactual values:

$$\Delta K_{i,t}\% = \frac{\left(K_{i,t}^{c} - K_{i,t}^{b}\right)}{K_{i,t}^{b}} \times 100,$$

where $K_{i,t}$ is calculated as given by equation (25), and $K_{i,t}^{b}$ and $K_{i,t}^{c}$ are the baseline and counterfactual capital stocks, respectively. The results for the world are calculated by summing over all countries, i.e., $\Delta K_{\text{World},t}\% = \left(\sum_i K_{i,t}^{c} - \sum_i K_{i,t}^{b}\right) / \left(\sum_i K_{i,t}^{b}\right) \times 100$. For NAFTA, we only sum capital stocks over the three NAFTA members in the baseline and counterfactual and calculate the change of this sum, while the results for ROW are calculated as the change of the sum of capital stocks for the remaining 79 countries.

J Additional Results for the NAFTA Counterfactual

In this section we provide a review of findings of related NAFTA studies and we offer more detailed results for our NAFTA counterfactual. We also provide a general discussion of the effects of trade liberalization, such as NAFTA, in our framework.

Arguably, NAFTA is among the most widely studied free trade agreements. Very often the effects of NAFTA have been evaluated with the gravity model. For example, using gravity estimates, Krueger (1999) finds an increase of trade among NAFTA members of 46%. Lederman et al. (2005) provides a detailed summary of many studies and finds, again using gravity based estimates, effects on trade flows of NAFTA of about 40%. These authors conclude that the bulk of the rise in trade as a consequence of NAFTA is due to income effects, both static and dynamic through capital accumulation. Romalis (2007) finds trade effects within NAFTA of up to nearly 30%, while the resulting welfare effects are small. Trefler (2004) highlights the short- and long-run effects of the Canada-United States Free Trade Agreement, showing that low-productivity plants reduced employment by 12% while industry level labor productivity increased by 15%. Overall, the Canada-United States Free Trade Agreement was welfare-enhancing according to a simple welfare analysis undertaken. Anderson and Yotov (2016) offer static general equilibrium analysis of the effects of NAFTA. They find a 6% increase in the real GDP for Mexico and small (less than 1%) positive welfare effects for Canada and U.S. Caliendo and Parro (2015) find the largest increase in exports and imports for Mexico (up to 14%), followed by the United States and Canada. The welfare effects, measured by real wages, were positive in all NAFTA countries, with Mexico having the largest gains of up to 1.5%. There is also a related evaluation of the effects of NAFTA in the computational general equilibrium literature, see for example McCleery (1992), Klein and Salvatore (1995), Brown et al. (1992a,b), Fox (1999), Kehoe (2003), Rolleigh (2013) and Shikher (2012).

We provide further details to our NAFTA counterfactual in Table A4. Specifically, we report the changes in trade, MR, welfare, and capital stocks for all countries, as well as summary statistics for the NAFTA members, the non-NAFTA members and the world as a whole. All changes are calculated as described in online Appendix I, Step 4. The relationships between growth/capital accumulation and trade underlying the NAFTA counterfactual are illustrated by a hypothetical trade liberalization scenario acting on system (20)-(25).

Several findings stand out. First, the direct (partial-equilibrium) effect of a fall in $t_{ij,t}$ is an immediate increase in bilateral trade between partners i and j at time t without any implications for the rest of the countries. This effect is captured by equation (20) for given output and multilateral resistances. Second, trade liberalization between countries i and j at time t has an indirect effect on trade flows through the MRs given in equations (21) and (22). A reduction in trade costs between any two countries affects trade flows between all other country pairs in time t through their MRs. Hence, those terms capture the third-country effects through trade creation and trade diversion. In particular, opening to trade between countries i and j will translate into lower MRs (lower resistance for producers and lower prices for consumers) in the liberalizing countries, while producers and consumers in the rest of the world will suffer higher trade resistance.

Third, and most important for the purposes of this paper, trade liberalization acts on output and capital accumulation via changes in prices in the world. In combination, equations (23)-(24) depict the contemporaneous effects of changes in trade costs on factory-gate prices $p_{j,t}$, and on the values of domestic production/income $Y_{j,t}$. Intuitively, equation (23) captures the fact that a lower trade resistance (i.e., a lower outward multilateral resistance) faced by the producers in a liberalizing country translates into higher factory-gate prices. The latter will lead to an increase in the values of domestic production/income via equation (24). The opposite happens in outside countries, which now face higher trade resistance. Importantly, these effects are channeled through the outward multilateral resistance, which, as discussed above, means that a change in trade costs between any two countries may affect prices and output in any other country in the world.

Fourth, equation (25) captures the effects of trade liberalization on capital accumulation. These effects are channeled through the factory-gate prices $p_{j,t}$ and through the inward MRs. A change in trade costs will cause a change in factory-gate prices via equation (23). In response, a change in the capital stock begins via equation (25). As discussed earlier, the relationship between prices of domestically produced goods and capital accumulation is direct. We demonstrate that trade liberalization will result in higher factory-gate prices, leading to more investment for the liberalizing countries, and in lower factory-gate prices, leading to less investment for outsiders. The relationship between capital accumulation and the inward multilateral resistance $P_{j,t}$ is inverse (see equation (25)). Trade liberalization will lead to lower MRs followed by more investment in the liberalizing countries, and to higher MRs followed by lower investment in outside countries. The changes in the MRs can be viewed as an embedded capital accumulation effect of trade liberalization. In combination, accumulation has elasticity with respect to the terms of trade $p_{j,t}/P_{j,t}$ equal to δ, the depreciation rate.

Finally, we note that the changes in the value of output will have additional (direct and indirect) effects on trade and world prices. The direct, positive effects of output on trade are captured by equation (20). In addition, changes in output will affect trade flows indirectly via changes in the multilateral resistances that are captured by equations (21) and (22). In turn, the changes in the MRs will lead to additional, third-order changes in output and capital accumulation, and so forth.

Table A4: Evaluation of NAFTA

	Trade effects			MR effects			Welfare effects			Capital
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Country	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Full Dynamic GE, trans.
AGO	-0.575	-0.520	-0.376	0.034	0.048	0.081	-0.034	-0.059	-0.079	-0.093
ARG	-0.437	-0.383	-0.252	0.007	0.022	0.059	-0.007	-0.012	-0.016	-0.019
AUS	-0.323	-0.283	-0.182	0.007	0.023	0.059	-0.007	-0.013	-0.018	-0.021
AUT	-0.038	-0.023	0.016	0.005	0.021	0.057	-0.005	-0.009	-0.013	-0.015
AZE	-0.261	-0.222	-0.128	0.005	0.021	0.057	-0.005	-0.010	-0.013	-0.015
BEL	-0.018	-0.009	0.019	0.012	0.027	0.062	-0.012	-0.021	-0.027	-0.032
BGD	-0.415	-0.362	-0.234	0.003	0.019	0.055	-0.003	-0.005	-0.008	-0.009
BGR	-0.037	-0.020	0.022	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
BLR	-0.012	0.004	0.042	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.002
BRA	-0.652	-0.577	-0.396	0.006	0.022	0.058	-0.006	-0.011	-0.016	-0.019
CAN	66.950	69.652	76.053	-2.843	-3.050	-3.520	2.927	5.859	9.572	12.899
CHE	-0.090	-0.076	-0.033	0.017	0.032	0.066	-0.017	-0.029	-0.038	-0.044
CHL	-0.652	-0.586	-0.418	0.027	0.042	0.075	-0.027	-0.048	-0.064	-0.076
CHN	-0.553	-0.489	-0.333	0.008	0.024	0.060	-0.008	-0.015	-0.020	-0.024

Continued on next page

Table A4 – *Continued from previous page*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Trade effects			MR effects			Welfare effects			Capital
Country	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Full Dynamic GE, trans.
COL	-1.447	-1.296	-0.936	0.015	0.030	0.066	-0.015	-0.027	-0.036	-0.043
CZE	-0.018	-0.003	0.034	0.002	0.018	0.055	-0.002	-0.003	-0.005	-0.006
DEU	-0.099	-0.080	-0.029	0.008	0.023	0.059	-0.008	-0.014	-0.019	-0.022
DNK	-0.052	-0.037	0.004	0.006	0.022	0.058	-0.006	-0.011	-0.016	-0.019
DOM	-1.407	-1.274	-0.943	0.023	0.038	0.073	-0.023	-0.041	-0.056	-0.067
ECU	-0.689	-0.619	-0.442	0.018	0.033	0.068	-0.018	-0.032	-0.044	-0.052
EGY	-0.205	-0.173	-0.094	0.002	0.018	0.055	-0.002	-0.004	-0.006	-0.007
ESP	-0.109	-0.087	-0.031	0.005	0.020	0.057	-0.005	-0.009	-0.012	-0.014
ETH	-0.208	-0.175	-0.095	0.001	0.017	0.054	-0.001	-0.002	-0.002	-0.003
FIN	-0.077	-0.060	-0.015	0.008	0.024	0.060	-0.008	-0.015	-0.020	-0.024
FRA	-0.094	-0.074	-0.023	0.005	0.021	0.057	-0.005	-0.009	-0.013	-0.015
GBR	-0.215	-0.186	-0.109	0.010	0.025	0.061	-0.010	-0.017	-0.023	-0.028
GHA	-0.325	-0.282	-0.175	0.004	0.020	0.057	-0.004	-0.008	-0.011	-0.013
GRC	-0.046	-0.029	0.015	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.003
GTM	-1.846	-1.669	-1.235	0.031	0.046	0.080	-0.031	-0.056	-0.076	-0.090
HKG	-0.162	-0.140	-0.079	0.012	0.028	0.063	-0.012	-0.022	-0.030	-0.035
HRV	-0.067	-0.047	0.002	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
HUN	-0.029	-0.014	0.025	0.003	0.019	0.056	-0.003	-0.005	-0.008	-0.009
IDN	-0.167	-0.141	-0.075	0.003	0.019	0.055	-0.003	-0.005	-0.007	-0.009
IND	-0.333	-0.289	-0.182	0.002	0.018	0.055	-0.002	-0.004	-0.005	-0.006
IRL	-0.066	-0.066	-0.043	0.032	0.046	0.077	-0.032	-0.055	-0.071	-0.081
IRN	-0.032	-0.016	0.025	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
IRQ	-0.531	-0.473	-0.328	0.018	0.034	0.068	-0.018	-0.033	-0.044	-0.052
ISR	-0.509	-0.465	-0.342	0.033	0.048	0.081	-0.033	-0.058	-0.078	-0.093
ITA	-0.103	-0.081	-0.027	0.004	0.020	0.056	-0.004	-0.007	-0.010	-0.012
JPN	-0.634	-0.562	-0.388	0.009	0.024	0.060	-0.009	-0.016	-0.021	-0.025
KAZ	-0.130	-0.103	-0.038	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
KEN	-0.206	-0.173	-0.093	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
KOR	-0.402	-0.357	-0.242	0.017	0.033	0.067	-0.017	-0.031	-0.041	-0.049
KWT	-0.164	-0.139	-0.075	0.005	0.021	0.058	-0.005	-0.010	-0.014	-0.017
LBN	-0.124	-0.100	-0.041	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
LKA	-0.364	-0.317	-0.204	0.004	0.020	0.057	-0.004	-0.008	-0.011	-0.013
LTU	-0.154	-0.127	-0.060	0.006	0.021	0.058	-0.006	-0.010	-0.014	-0.016
MAR	-0.154	-0.127	-0.060	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
MEX	70.060	71.784	75.893	-1.733	-1.864	-2.168	1.764	3.532	5.748	7.778
MYS	-0.181	-0.169	-0.120	0.032	0.047	0.079	-0.032	-0.056	-0.074	-0.087
NGA	-0.453	-0.411	-0.295	0.029	0.044	0.077	-0.029	-0.051	-0.069	-0.081
NLD	-0.037	-0.025	0.010	0.009	0.024	0.060	-0.009	-0.016	-0.022	-0.026
NOR	-0.310	-0.283	-0.198	0.037	0.051	0.082	-0.037	-0.065	-0.084	-0.097
NZL	-0.291	-0.254	-0.160	0.010	0.026	0.062	-0.010	-0.018	-0.025	-0.030
OMN	-0.098	-0.079	-0.029	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
PAK	-0.335	-0.290	-0.181	0.002	0.018	0.054	-0.002	-0.003	-0.005	-0.006
PER	-1.218	-1.092	-0.787	0.026	0.041	0.075	-0.026	-0.046	-0.062	-0.073
PHL	-0.346	-0.305	-0.200	0.008	0.024	0.060	-0.008	-0.014	-0.020	-0.023
POL	-0.027	-0.011	0.028	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
PRT	-0.049	-0.032	0.011	0.003	0.018	0.055	-0.003	-0.005	-0.007	-0.008
QAT	-0.037	-0.023	0.015	0.003	0.019	0.056	-0.003	-0.006	-0.009	-0.011
ROM	-0.041	-0.024	0.019	0.001	0.017	0.054	-0.001	-0.003	-0.004	-0.004
RUS	-0.115	-0.091	-0.031	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
SAU	-0.325	-0.286	-0.186	0.010	0.026	0.062	-0.010	-0.018	-0.025	-0.030
SDN	-0.131	-0.105	-0.040	0.002	0.018	0.054	-0.002	-0.003	-0.005	-0.005
SER	-0.057	-0.038	0.010	0.001	0.017	0.053	-0.001	-0.001	-0.002	-0.002
SGP	-0.013	-0.028	-0.028	0.042	0.055	0.084	-0.042	-0.072	-0.092	-0.105
SVK	-0.007	0.007	0.043	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
SWE	-0.063	-0.048	-0.007	0.008	0.024	0.060	-0.008	-0.015	-0.021	-0.025
SYR	-0.050	-0.033	0.011	0.003	0.018	0.055	-0.003	-0.005	-0.007	-0.008
THA	-0.236	-0.205	-0.126	0.009	0.025	0.061	-0.009	-0.016	-0.022	-0.026
TKM	-0.024	-0.007	0.034	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
TUN	-0.034	-0.017	0.024	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
TUR	-0.107	-0.084	-0.027	0.002	0.018	0.055	-0.002	-0.004	-0.005	-0.006
TZA	-0.138	-0.111	-0.045	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004

Continued on next page

Table A4 – *Continued from previous page*

	Trade effects			MR effects			Welfare effects			Capital
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Country	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Full Dynamic GE, trans.
UKR	-0.052	-0.032	0.014	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.003
USA	32.382	33.103	34.798	-0.315	-0.331	-0.372	0.316	0.637	1.031	1.428
UZB	-0.044	-0.026	0.019	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
VEN	-1.153	-1.039	-0.759	0.024	0.039	0.074	-0.024	-0.043	-0.059	-0.070
VNM	-0.172	-0.146	-0.081	0.006	0.022	0.059	-0.006	-0.012	-0.016	-0.020
ZAF	-0.242	-0.207	-0.122	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
ZWE	-0.085	-0.064	-0.011	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.002
World	6.500	6.657	7.024	-0.051	-0.040	-0.016	0.171	0.344	0.562	0.767
NAFTA	100.028	102.824	109.461	-1.631	-1.748	-2.020	0.630	1.265	2.056	2.496
ROW	-0.467	-0.412	-0.276	0.009	0.025	0.061	-0.007	-0.013	-0.018	-0.021

Notes: This table reports results from our NAFTA counterfactual. It is based on observed data on labor endowments and GDPs for our sample of 82 countries. Further, it uses our estimated trade costs based on equation (30) and recovered theory-consistent, steady-state capital stocks according to the capital accumulation equation (25). We calculate baseline preference-adjusted technology A_j/γ_j according to the market-clearing equation (23) and the production function equation (24). Finally, the counterfactual is based on our own estimates of the elasticity of substitution $\widehat{\sigma} = 5.847$, the share of capital in the Cobb-Douglas production function $\widehat{\alpha} = 0.545$, and the capital depreciation rate $\widehat{\delta} = 0.061$. The consumers' discount factor β is set equal to 0.98. Column (1) gives the country abbreviations. Columns (2) to (4) report the percentage change in exports for the NAFTA counterfactual for each country, for the world as a whole, the NAFTA and the non-NAFTA countries (summarized as Rest Of the World, ROW) for three different scenarios. The "Cond. GE" scenario takes into account the direct and indirect trade cost changes but holds GDPs constant, the "Full Static GE" scenario additionally takes general equilibrium income effects into account, and the "Full Dynamic GE, trans." scenario adds the capital accumulation effects. For the latter, we report the results from the steady state taking into account that changes take time to materialize. Columns (5) to (7) report the percentage change in the multilateral resistance terms for each country for the same three scenarios. Similarly, columns (8) to (10) give the welfare effects. The last column shows the percentage change in capital stocks for each country for the "Full Dynamic GE, trans." scenario. Further details to the counterfactuals can be found in Section 5 and online Appendix I.

K Linear Capital Accumulation Function

In this section, we investigate the consequences of the convenient log-linear capital accumulation function by deriving our system under the assumption that capital accumulation is subject to the more standard linear transition function:

$$K_{j,t+1} = \Omega_{j,t} + (1-\delta)K_{j,t}. \tag{A42}$$

Start with the utility function:

$$U_{j,t} = \sum_{t=0}^{\infty} \beta^t \ln(C_{j,t}).$$

Combine the budget constraint with the production function:

$$P_{j,t}C_{j,t} + P_{j,t}\Omega_{j,t} = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

Use the linear transition function for capital to express $\Omega_{j,t}$ as $K_{j,t+1} - (1-\delta)K_{j,t}$:

$$P_{j,t}C_{j,t} + P_{j,t}\left(K_{j,t+1} - (1-\delta)K_{j,t}\right) = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

Set up the Lagrangian:

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \left[\ln(C_{j,t}) + \lambda_{j,t}\left(\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(K_{j,t+1} - (1-\delta)K_{j,t}\right)\right)\right].$$

Take derivatives with respect to $C_{j,t}$, $K_{j,t+1}$ and $\lambda_{j,t}$:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial C_{j,t}} &= \frac{\beta^t}{C_{j,t}} - \beta^t \lambda_{j,t}P_{j,t} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t. \\
\frac{\partial \mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1}\lambda_{j,t+1}\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1} - \beta^t\lambda_{j,t}P_{j,t} \\
&\quad + \beta^{t+1}\lambda_{j,t+1}P_{j,t+1}(1-\delta) \overset{!}{=} 0 \quad \text{for all } j \text{ and } t. \\
\frac{\partial \mathcal{L}}{\partial \lambda_{j,t}} &= \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(K_{j,t+1} - (1-\delta)K_{j,t}\right) \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.
\end{aligned}$$

Use the first-order condition for consumption to express $\lambda_{j,t}$ as:

$$\lambda_{j,t} = \frac{1}{C_{j,t}P_{j,t}} \quad \text{for all } j \text{ and } t.$$

Replace this in the first-order condition for capital:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1}\frac{1}{C_{j,t+1}P_{j,t+1}}\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1} - \beta^t\frac{1}{C_{j,t}} \\
&\quad + \beta^{t+1}\frac{1}{C_{j,t+1}}(1-\delta) \overset{!}{=} 0 \quad \text{for all } j \text{ and } t.
\end{aligned}$$

Simplify and re-arrange:

$$\frac{\beta\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1}}{C_{j,t+1}P_{j,t+1}} = \frac{1}{C_{j,t}} - \frac{\beta}{C_{j,t+1}}(1-\delta) \quad \text{for all } j \text{ and } t.$$

Use the definition of $Y_{j,t}$ to re-write the left-hand side of the above expression:

$$\frac{\alpha\beta\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}C_{j,t+1}P_{j,t+1}} = \frac{1}{C_{j,t}} - \frac{\beta(1-\delta)}{C_{j,t+1}} \quad \text{for all } j \text{ and } t.$$

Rearrange to obtain:

$$\frac{1}{C_{j,t}} = \frac{\beta}{C_{j,t+1}}\left(\frac{\alpha\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}P_{j,t+1}} + 1 - \delta\right) \quad \text{for all } j \text{ and } t,$$

which is the familiar and standard consumption Euler equation. Note that there are three forward-looking variables for each country in this system: $Y_{j,t}$, $C_{j,t}$, and $P_{j,t}$ ($K_{j,t+1}$ is determined in t and therefore it is not a forward-looking variable). Thus, overall, we have $3N$ forward-looking variables in this system. These are, alongside $\Pi_{j,t}$ and $K_{j,t}$, also the endogenous variables we have to solve for.

Since there exists no analytical solution for this system, we feed the following set of equations into Dynare:

$$\begin{aligned}
Y_{j,t} &= \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j P_{j,t}} A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} \quad \text{for all } j \text{ and } t,\\
Y_t &= \sum_j Y_{j,t} \quad \text{for all } t,\\
Y_{j,t} &= P_{j,t}C_{j,t} + P_{j,t}\left(K_{j,t+1} - (1-\delta)K_{j,t}\right) \quad \text{for all } j \text{ and } t,\\
P_{j,t} &= \left[\sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t}\right]^{\frac{1}{1-\sigma}} \quad \text{for all } j \text{ and } t,\\
\Pi_{i,t} &= \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{\phi_{j,t}Y_{j,t}}{Y_t}\right]^{\frac{1}{1-\sigma}} \quad \text{for all } i \text{ and } t,\\
\frac{1}{C_{j,t}} &= \frac{\beta}{C_{j,t+1}}\left(\frac{\alpha\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}P_{j,t+1}} + 1 - \delta\right) \quad \text{for all } j \text{ and } t.
\end{aligned}$$

The first equation is the production function from equation (24) replacing $p_{j,t}$ using equation (23). The second equation is the definition of world GDP. The third equation is the budget constraint, where we use equation (A42) to replace $\Omega_{j,t}$. The fourth and fifth equations are the MRs as given by equations (21) and (22), respectively, and the last equation is the Euler equation just derived above. The Euler equation is the only main difference between our main system and the corresponding system obtained under linear capital accumulation (compare these equations to the ones we used in Dynare for our original system given in equations (A12)-(A17); the other difference is the way investments are expressed in the third equation of the systems). Finally, we note that, similar to the case of Cobb-Douglas capital accumulation, we can demonstrate (following the steps in Section A.2) that the transversality condition is also satisfied in the case of linear capital accumulation.

We also can formulate the original system for the case of a linear capital accumulation function:

$$
\begin{aligned}
X_{ij,t} &= \frac{Y_{i,t}\phi_{j,t}Y_{j,t}}{Y_t}\left(\frac{t_{ij,t}}{\Pi_{i,t}P_{j,t}}\right)^{1-\sigma}, && \text{(A43)}\\
P_{j,t} &= \left[\sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t}\right]^{\frac{1}{1-\sigma}}, && \text{(A44)}\\
\Pi_{i,t} &= \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{\phi_{j,t}Y_{j,t}}{Y_t}\right]^{\frac{1}{1-\sigma}}, && \text{(A45)}\\
p_{j,t} &= \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j\Pi_{j,t}}, && \text{(A46)}\\
Y_{j,t} &= p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}, && \text{(A47)}\\
\frac{1}{C_{j,t}} &= \frac{\beta}{C_{j,t+1}}\left(\frac{\alpha\phi_{j,t+1}Y_{j,t+1}}{K_{j,t+1}P_{j,t+1}}+1-\delta\right), && \text{(A48)}\\
K_{j,0} & \text{ given.}
\end{aligned}
$$

When we compare the above equations with our original system given by equations (20)-(25), we see that the only differing equation is the expression for capital accumulation. As noted above, equation (A48) is the consumption Euler equation, which gives an expression for the relationship that determines investment and, hence, capital stocks, but it no longer offers an analytical expression for next period capital stocks.

What does this new system imply for our results?

1. Concerning the empirical specification, we see that the trade cost estimates and the output equation estimates do not change at all. Therefore, trade costs $t_{ij,t}^{1-\sigma}$, the capital share α, and the elasticity of substitution σ can be estimated as in the case with the Cobb-Douglas transition function. However, as we no longer have a closed-form solution for our policy function, we cannot derive an estimable *Capital equation* and, therefore, we are no longer able to back out the depreciation rate δ and test for causal effects of trade on capital accumulation.

2. The steady state version of equation (A48) is:

$$
\begin{aligned}
\frac{1}{C_j} &= \frac{\beta}{C_j}\left(\frac{\alpha\phi_jY_j}{K_jP_j}+1-\delta\right) \Rightarrow\\
K_j &= \frac{\alpha\phi_jY_j}{\left(\frac{1}{\beta}-1+\delta\right)P_j} = \frac{\alpha\beta\phi_jY_j}{(1-\beta+\beta\delta)P_j}.
\end{aligned}
$$

Given this solution for the steady-state capital stock, which is again a function of parameters and Y_j/P_j, all our analytical insights from Section 3.1 go through. Actually, the only difference to the case with log-linear capital accumulation is the missing δ in the numerator for the steady-state capital stock. However, when plugging in $\phi_j Y_j = P_j C_j + P_j (K_j - (1-\delta)K_j) = P_j C_j + \delta P_j K_j$, we see that δ reappears. From this equation we also can calculate steady-state consumption:

$$\begin{aligned} C_j &= \frac{\phi_j Y_j}{P_j} - \delta K_j = \frac{\phi_j Y_j}{P_j} - \frac{\alpha\beta\delta\phi_j Y_j}{(1-\beta+\beta\delta) P_j} = \\ &= \left[\frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta}\right] \frac{\phi_j Y_j}{P_j}. \end{aligned}$$

This demonstrates that consumption is given by exactly the same function as in the case of our Cobb-Douglas transition function for capital in steady state. Similarly, the level of investment $\delta K_{j,t}$ is identical. With our estimated parameters of $\alpha = 0.545$, $\beta = 0.98$, $\delta = 0.061$, we end up with $\Omega_j P_j / (\phi_j Y_j) = 0.4084$ and $C_j P_j / (\phi_j Y_j) = 0.5916$ in steady state. Note, however, that the steady-state capital stock as a share of GDP is now given by $K_j P_j / (\phi_j Y_j) = 6.6947$.

3. Finally, for our counterfactuals, we have to back out A_j/γ_j. This can be done in the exact same fashion as in the case with the log-linear transition function for capital, given that we can determine the steady-state capital stock.

We provide detailed results for our NAFTA counterfactual using the linear capital accumulation function in Table A5. Specifically, we report the changes in trade, MR, welfare, and capital stocks for all countries, as well as summary statistics for the NAFTA members, the non-NAFTA members and the world as a whole. All changes are calculated as described in online Appendix I, Step 4. When comparing the results with the one of our log-linear transition function for capital, we see that all results besides the welfare effects are identical. The reason is that the steady states do not change, and only welfare is calculated as a discounted sum.

Table A5: Evaluation of NAFTA with Linear Capital Accumulation Function

	Trade effects			MR effects			Welfare effects			Capital
(1) Country	(2) Cond. GE	(3) Full Static GE	(4) Full Dynamic GE, trans.	(5) Cond. GE	(6) Full Static GE	(7) Full Dynamic GE, trans.	(8) Cond. GE	(9) Full Static GE	(10) Full Dynamic GE, trans.	(11) Full Dynamic GE, trans.
AGO	-0.575	-0.520	-0.376	0.034	0.048	0.081	-0.034	-0.059	-0.076	-0.093
ARG	-0.437	-0.383	-0.252	0.007	0.022	0.059	-0.007	-0.012	-0.016	-0.019
AUS	-0.323	-0.283	-0.182	0.007	0.023	0.059	-0.007	-0.013	-0.017	-0.021
AUT	-0.038	-0.023	0.016	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
AZE	-0.261	-0.222	-0.128	0.005	0.021	0.057	-0.005	-0.010	-0.013	-0.015
BEL	-0.018	-0.009	0.019	0.012	0.027	0.062	-0.012	-0.021	-0.026	-0.032
BGD	-0.415	-0.362	-0.234	0.003	0.019	0.055	-0.003	-0.005	-0.007	-0.009
BGR	-0.037	-0.020	0.022	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
BLR	-0.012	0.004	0.042	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.002
BRA	-0.652	-0.577	-0.396	0.006	0.022	0.058	-0.006	-0.011	-0.015	-0.019
CAN	66.950	69.652	76.053	-2.843	-3.050	-3.520	2.927	5.859	9.545	12.899
CHE	-0.090	-0.076	-0.033	0.017	0.032	0.066	-0.017	-0.029	-0.037	-0.044
CHL	-0.652	-0.586	-0.418	0.027	0.042	0.075	-0.027	-0.048	-0.062	-0.076

Continued on next page

Table A5 – *Continued from previous page*

(1)	Trade effects (2)	(3)	(4)	MR effects (5)	(6)	(7)	Welfare effects (8)	(9)	(10)	Capital (11)
Country	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Cond. GE	Full Static GE	Full Dynamic GE, trans.	Full Dynamic GE, trans.
CHN	-0.553	-0.489	-0.333	0.008	0.024	0.060	-0.008	-0.015	-0.019	-0.024
COL	-1.447	-1.296	-0.936	0.015	0.030	0.066	-0.015	-0.027	-0.035	-0.043
CZE	-0.018	-0.003	0.034	0.002	0.018	0.055	-0.002	-0.003	-0.005	-0.006
DEU	-0.099	-0.080	-0.029	0.008	0.023	0.059	-0.008	-0.014	-0.018	-0.022
DNK	-0.052	-0.037	0.004	0.006	0.022	0.058	-0.006	-0.011	-0.015	-0.019
DOM	-1.407	-1.274	-0.943	0.023	0.038	0.073	-0.023	-0.041	-0.054	-0.067
ECU	-0.689	-0.619	-0.442	0.018	0.033	0.068	-0.018	-0.032	-0.042	-0.052
EGY	-0.205	-0.173	-0.094	0.002	0.018	0.055	-0.002	-0.004	-0.006	-0.007
ESP	-0.109	-0.087	-0.031	0.005	0.020	0.057	-0.005	-0.009	-0.011	-0.014
ETH	-0.208	-0.175	-0.095	0.001	0.017	0.054	-0.001	-0.002	-0.002	-0.003
FIN	-0.077	-0.060	-0.015	0.008	0.024	0.060	-0.008	-0.015	-0.019	-0.024
FRA	-0.094	-0.074	-0.023	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
GBR	-0.215	-0.186	-0.109	0.010	0.025	0.061	-0.010	-0.017	-0.022	-0.028
GHA	-0.325	-0.282	-0.175	0.004	0.020	0.057	-0.004	-0.008	-0.010	-0.013
GRC	-0.046	-0.029	0.015	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.003
GTM	-1.846	-1.669	-1.235	0.031	0.046	0.080	-0.031	-0.056	-0.073	-0.090
HKG	-0.162	-0.140	-0.079	0.012	0.028	0.063	-0.012	-0.022	-0.029	-0.035
HRV	-0.067	-0.047	0.002	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
HUN	-0.029	-0.014	0.025	0.003	0.019	0.056	-0.003	-0.005	-0.007	-0.009
IDN	-0.167	-0.141	-0.075	0.003	0.019	0.055	-0.003	-0.005	-0.007	-0.009
IND	-0.333	-0.289	-0.182	0.002	0.018	0.055	-0.002	-0.004	-0.005	-0.006
IRL	-0.066	-0.066	-0.043	0.032	0.046	0.077	-0.032	-0.055	-0.068	-0.081
IRN	-0.032	-0.016	0.025	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
IRQ	-0.531	-0.473	-0.328	0.018	0.034	0.068	-0.018	-0.033	-0.043	-0.052
ISR	-0.509	-0.465	-0.342	0.033	0.048	0.081	-0.033	-0.058	-0.076	-0.093
ITA	-0.103	-0.081	-0.027	0.004	0.020	0.056	-0.004	-0.007	-0.010	-0.012
JPN	-0.634	-0.562	-0.388	0.009	0.024	0.060	-0.009	-0.016	-0.020	-0.025
KAZ	-0.130	-0.103	-0.038	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
KEN	-0.206	-0.173	-0.093	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
KOR	-0.402	-0.357	-0.242	0.017	0.033	0.067	-0.017	-0.031	-0.040	-0.049
KWT	-0.164	-0.139	-0.075	0.005	0.021	0.058	-0.005	-0.010	-0.013	-0.017
LBN	-0.124	-0.100	-0.041	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
LKA	-0.364	-0.317	-0.204	0.004	0.020	0.057	-0.004	-0.008	-0.011	-0.013
LTU	-0.154	-0.127	-0.060	0.006	0.021	0.058	-0.006	-0.010	-0.013	-0.016
MAR	-0.154	-0.127	-0.060	0.004	0.019	0.056	-0.004	-0.007	-0.009	-0.011
MEX	70.060	71.784	75.893	-1.733	-1.864	-2.168	1.764	3.532	5.740	7.778
MYS	-0.181	-0.169	-0.120	0.032	0.047	0.079	-0.032	-0.056	-0.071	-0.087
NGA	-0.453	-0.411	-0.295	0.029	0.044	0.077	-0.029	-0.051	-0.066	-0.081
NLD	-0.037	-0.025	0.010	0.009	0.024	0.060	-0.009	-0.016	-0.021	-0.026
NOR	-0.310	-0.283	-0.198	0.037	0.051	0.082	-0.037	-0.065	-0.080	-0.097
NZL	-0.291	-0.254	-0.160	0.010	0.026	0.062	-0.010	-0.018	-0.024	-0.030
OMN	-0.098	-0.079	-0.029	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
PAK	-0.335	-0.290	-0.181	0.002	0.018	0.054	-0.002	-0.003	-0.004	-0.006
PER	-1.218	-1.092	-0.787	0.026	0.041	0.075	-0.026	-0.046	-0.060	-0.073
PHL	-0.346	-0.305	-0.200	0.008	0.024	0.060	-0.008	-0.014	-0.019	-0.023
POL	-0.027	-0.011	0.028	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
PRT	-0.049	-0.032	0.011	0.003	0.018	0.055	-0.003	-0.005	-0.006	-0.008
QAT	-0.037	-0.023	0.015	0.003	0.019	0.056	-0.003	-0.006	-0.009	-0.011
ROM	-0.041	-0.024	0.019	0.001	0.017	0.054	-0.001	-0.003	-0.004	-0.004
RUS	-0.115	-0.091	-0.031	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
SAU	-0.325	-0.286	-0.186	0.010	0.026	0.062	-0.010	-0.018	-0.024	-0.030
SDN	-0.131	-0.105	-0.040	0.002	0.018	0.054	-0.002	-0.003	-0.004	-0.005
SER	-0.057	-0.038	0.010	0.001	0.017	0.053	-0.001	-0.001	-0.002	-0.002
SGP	-0.013	-0.028	-0.028	0.042	0.055	0.084	-0.042	-0.072	-0.088	-0.105
SVK	-0.007	0.007	0.043	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
SWE	-0.063	-0.048	-0.007	0.008	0.024	0.060	-0.008	-0.015	-0.020	-0.025
SYR	-0.050	-0.033	0.011	0.003	0.018	0.055	-0.003	-0.005	-0.007	-0.008
THA	-0.236	-0.205	-0.126	0.009	0.025	0.061	-0.009	-0.016	-0.021	-0.026
TKM	-0.024	-0.007	0.034	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
TUN	-0.034	-0.017	0.024	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
TUR	-0.107	-0.084	-0.027	0.002	0.018	0.055	-0.002	-0.004	-0.005	-0.006

Continued on next page

Table A5 – *Continued from previous page*

(1) Country	Trade effects (2) Cond. GE	(3) Full Static GE	(4) Full Dynamic GE, trans.	MR effects (5) Cond. GE	(6) Full Static GE	(7) Full Dynamic GE, trans.	Welfare effects (8) Cond. GE	(9) Full Static GE	(10) Full Dynamic GE, trans.	Capital (11) Full Dynamic GE, trans.
TZA	-0.138	-0.111	-0.045	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.004
UKR	-0.052	-0.032	0.014	0.001	0.017	0.054	-0.001	-0.002	-0.003	-0.003
USA	32.382	33.103	34.798	-0.315	-0.331	-0.372	0.316	0.637	1.037	1.428
UZB	-0.044	-0.026	0.019	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.001
VEN	-1.153	-1.039	-0.759	0.024	0.039	0.074	-0.024	-0.043	-0.056	-0.070
VNM	-0.172	-0.146	-0.081	0.006	0.022	0.059	-0.006	-0.012	-0.016	-0.020
ZAF	-0.242	-0.207	-0.122	0.005	0.021	0.057	-0.005	-0.009	-0.012	-0.015
ZWE	-0.085	-0.064	-0.011	0.000	0.016	0.053	-0.000	-0.001	-0.001	-0.002
World	6.500	6.657	7.024	-0.051	-0.040	-0.016	0.171	0.344	0.564	0.767
NAFTA	100.028	102.824	109.461	-1.631	-1.748	-2.020	0.630	1.265	2.059	2.496
ROW	-0.467	-0.412	-0.276	0.009	0.025	0.061	-0.007	-0.013	-0.017	-0.021

Notes: This table reports results from our NAFTA counterfactual assuming a linear capital transition function. It is based on observed data on labor endowments and GDPs for our sample of 82 countries. Further, it uses our estimated trade costs based on equation (30) and recovered theory-consistent, steady-state capital stocks according to the capital accumulation equation (25). We calculate baseline preference-adjusted technology A_j/γ_j according to the market-clearing equation (23) and the production function equation (24). Finally, the counterfactual is based on our own estimates of the elasticity of substitution $\widehat{\sigma} = 5.847$, the share of capital in the Cobb-Douglas production function $\widehat{\alpha} = 0.545$, and the capital depreciation rate $\widehat{\delta} = 0.061$. The consumers' discount factor β is set equal to 0.98. Column (1) gives the country abbreviations. Columns (2) to (4) report the percentage change in exports for the NAFTA counterfactual for each country, for the world as a whole, the NAFTA and the non-NAFTA countries (summarized as Rest Of the World, ROW) for three different scenarios. The "Cond. GE" scenario takes into account the direct and indirect trade cost changes but holds GDPs constant, the "Full Static GE" scenario additionally takes general equilibrium income effects into account, and the "Full Dynamic GE, trans." scenario adds the capital accumulation effects. For the latter, we report the results from the steady state taking into account that changes take time to materialize. Columns (5) to (7) report the percentage change in the multilateral resistance terms for each country for the same three scenarios. Similarly, columns (8) to (10) give the welfare effects. The last column shows the percentage change in capital stocks for each country for the "Full Dynamic GE, trans." scenario. Further details to the counterfactuals can be found in Section 5 and online Appendix I.

To further compare the log-linear capital transition function with the linear one, we re-simulate both models with a depreciation rate half the value of the original one ($\delta = 0.03$ instead of $\delta = 0.061$). Note that the depreciation rate is the only parameter that cannot be recovered with the linear transition function for capital. Figure 4 plots the comparison for the capital transition for both cases, similar as Figure 3 for the baseline value of $\delta = 0.061$. Our main findings are that the capital accumulation effects generated with the linear transition function are more pronounced immediately after the implementation of NAFTA both for member and for non-member countries, and that the dynamic NAFTA effects are exhausted a bit faster with the linear capital accumulation function also hold with a lower depreciation rate. The differences in the transition of capital between the linear and the log-linear transition function of capital are a bit larger with a lower depreciation rate. However, the welfare effects obtained with the linear versus the log-linear capital transition function are again very similar. The average welfare effect for the NAFTA members is 1.80, and identical up to the second digit between the two cases. Also the results for the World (0.49) and for the rest of the world (-0.016) are identical up to the second digit with a depreciation rate of $\delta = 0.3$.

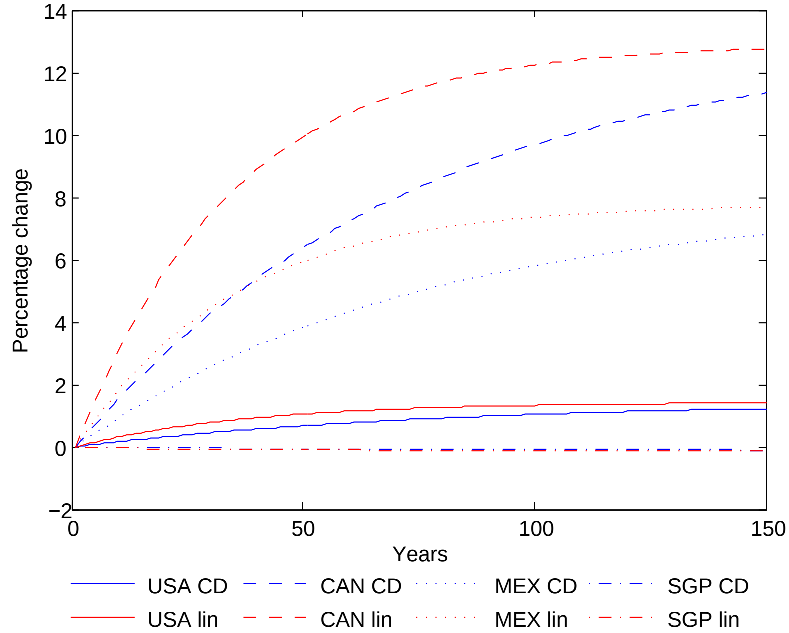

Figure 4: Linear vs. Log-Linear (Cobb-Douglas, CD) Capital Accumulation

L Solution of the Upper Level with Intermediates

This section extends our model to allow for intermediates. Intermediates in country j at time t, $Q_{j,t}$, are assumed as an additional production factor in our Cobb-Douglas production function following Eaton and Kortum (2002) and Caliendo and Parro (2015).

L.1 Derivation of the Policy Functions of the Upper Level with Intermediates

While α still denotes the capital share of production, we now introduce ξ as the labor share of production. The share of intermediates is then given by $1-\alpha-\xi$. We assume that intermediates are CES composites of domestic components ($q_{jj,t}$) and imported components from all other countries $i \neq j$ ($q_{ij,t}$), i.e., $Q_{j,t} = \left(\sum_i \gamma_i^{(1-\sigma)/\sigma} q_{ij,t}^{(\sigma-1)/\sigma}\right)^{\sigma/(\sigma-1)}$. All other assumptions are maintained.

Define the upper-level optimization problem with intermediates:

$$\max_{\{C_{j,t},\Omega_{j,t},Q_{j,t}\}} \quad \sum_{t=0}^{\infty} \beta^t \ln(C_{j,t}) \tag{A49}$$

$$K_{j,t+1} = \Omega_{j,t}^{\delta} K_{j,t}^{1-\delta}, \ \forall t \tag{A50}$$

$$Y_{j,t} = p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}, \ \forall t \tag{A51}$$

$$E_{j,t} = P_{j,t} C_{j,t} + P_{j,t}\Omega_{j,t} + P_{j,t} Q_{j,t}, \ \forall t \tag{A52}$$

$$E_{j,t} = \phi_{j,t} Y_{j,t}, \ \forall t \tag{A53}$$

$$K_{j,0} \quad \text{given.} \tag{A54}$$

Solve for $C_{j,t}$ using (A52) and (A53) to obtain $C_{j,t} = \phi_{j,t} Y_{j,t}/P_{j,t} - \Omega_{j,t} - Q_{j,t}$. Use $Y_{j,t}$, as given by (A51), and plug in for $Y_{j,t}$ in $C_{j,t} = \phi_{j,t} Y_{j,t}/P_{j,t} - \Omega_{j,t} - Q_{j,t}$:

$$C_{j,t} = \phi_{j,t} p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}/P_{j,t} - \Omega_{j,t} - Q_{j,t}.$$

Use (A50) to replace $\Omega_{j,t}$:

$$C_{j,t} = \phi_{j,t} p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta} - Q_{j,t}.$$

Define the following objective function:

$$\max_{\{K_{j,t},Q_{j,t}\}} \sum_{t=0}^{\infty} \beta^t \ln\left[\phi_{j,t} p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi}/P_{j,t} - \left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta} - Q_{j,t}\right].$$

Obtain first-order conditions:

$$\frac{\beta^t}{C_{j,t}}\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}} - \frac{(\delta-1)}{\delta} K_{j,t+1}^{1/\delta} K_{j,t}^{-1/\delta}\right) - \frac{1}{\delta}\frac{\beta^{t-1}}{C_{j,t-1}} K_{j,t-1}^{(\delta-1)/\delta} K_{j,t}^{1/\delta-1} \stackrel{!}{=} 0, \tag{A55}$$

$$\frac{\beta^t}{C_{j,t}}\left(\frac{(1-\alpha-\xi)\phi_{j,t}Y_{j,t}}{P_{j,t}Q_{j,t}}-1\right)\stackrel{!}{=}0, \tag{A56}$$

which hold for all j's and t's.

Simplify the first-order condition in equation (A56):

$$(1-\alpha-\xi)\phi_{j,t}Y_{j,t}\stackrel{!}{=}P_{j,t}Q_{j,t}. \tag{A57}$$

Simplify the first-order condition in equation (A55):

$$\frac{\delta\beta C_{j,t-1}}{C_{j,t}}\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)\stackrel{!}{=}K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}. \tag{A58}$$

Replace $C_{j,t}$ and $C_{j,t-1}$ by $C_{j,t}=\phi_{j,t}Y_{j,t}/P_{j,t}-\Omega_{j,t}-Q_{j,t}$ using $Q_{j,t}=(1-\alpha-\xi)\phi_{j,t}Y_{j,t}/P_{j,t}$ and $\Omega_{j,t}=\left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}$:

$$\frac{\delta\beta\left(\left(\alpha+\xi\right)\phi_{j,t-1}Y_{j,t-1}/P_{j,t-1}-\left(K_{j,t}/K_{j,t-1}^{1-\delta}\right)^{1/\delta}\right)}{\left(\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}/P_{j,t}-\left(K_{j,t+1}/K_{j,t}^{1-\delta}\right)^{1/\delta}\right)}\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)$$
$$\stackrel{!}{=}K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\Rightarrow$$

$$\delta\beta\left(\frac{\left(\alpha+\xi\right)\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\right)\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)$$
$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\Rightarrow$$

$$\delta\beta\left(\frac{\left(\alpha+\xi\right)\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\right)\left(\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}-\frac{(\delta-1)}{\delta}K_{j,t+1}^{1/\delta}K_{j,t}^{-1/\delta}\right)$$
$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t+1}^{1/\delta}\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-\frac{(\delta-1)\delta\beta\left(\alpha+\xi\right)}{\delta}\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$
$$-\delta\beta\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\alpha\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}+\frac{\delta\beta(\delta-1)}{\delta}\left(\frac{K_{j,t+1}K_{j,t}}{K_{j,t}K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\stackrel{!}{=}\frac{K_{j,t-1}^{(\delta-1)/\delta}K_{j,t}^{1/\delta-1}\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t-1}^{(\delta-1)/\delta}K_{j,t+1}^{1/\delta}\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-(\delta-1)\beta\left(\alpha+\xi\right)\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$

$$-\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}}{P_{j,t}K_{j,t}}+\beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\overset{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t+1}^{1/\delta}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-(\delta-1)\beta\left(\alpha+\xi\right)\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$

$$+\beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\overset{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}}{P_{j,t}}-K_{j,t+1}^{1/\delta}+\frac{\alpha\beta\delta\phi_{j,t}Y_{j,t}K_{j,t}^{1/\delta-1}}{P_{j,t}}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}K_{j,t}P_{j,t-1}}-(\delta-1)\beta\left(\alpha+\xi\right)\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{1/\delta}P_{j,t-1}}$$

$$+\beta(\delta-1)\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\overset{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta-1}\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)-K_{j,t+1}^{1/\delta}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}}-(\delta-1)\beta\left(\alpha+\xi\right)\frac{K_{j,t+1}^{1/\delta}\phi_{j,t-1}Y_{j,t-1}}{K_{j,t}^{(1-\delta)/\delta}P_{j,t-1}}$$

$$+\beta(\delta-1)K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$

$$\overset{!}{=}K_{j,t-1}^{(\delta-1)/\delta}\left(\frac{K_{j,t}^{1/\delta}\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)-K_{j,t}K_{j,t+1}^{1/\delta}\right)\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}}-(\delta-1)\beta\left(\alpha+\xi\right)\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$$
$$+\beta(\delta-1)K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\overset{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)-K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}}+(1+\beta(\delta-1))K_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\overset{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)+(\delta-1)\beta\left(\alpha+\xi\right)\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}}+(1+\beta(\delta-1))K_{j,t}\frac{K_{j,t}^{(1-\delta)/\delta}}{K_{j,t}^{(1-\delta)/\delta}}\left(\frac{K_{j,t+1}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}$$
$$\overset{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)+(\delta-1)\beta\left(\alpha+\xi\right)\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}\Rightarrow$$

$$\frac{\alpha\beta\delta\left(\alpha+\xi\right)\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}{P_{j,t}P_{j,t-1}}+(1+\beta(\delta-1))\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}$$
$$\overset{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\left(\alpha+\xi+\alpha\beta\delta\right)+(\delta-1)\beta\left(\alpha+\xi\right)\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}\Rightarrow$$

$$\alpha\beta\delta\left(\alpha+\xi\right)+(1+\beta(\delta-1))\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t}P_{j,t-1}}{\phi_{j,t}Y_{j,t}\phi_{j,t-1}Y_{j,t-1}}$$
$$\overset{!}{=}\left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}}\left(\alpha+\xi+\alpha\beta\delta\right)+(\delta-1)\beta\left(\alpha+\xi\right)\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{1/\delta}\frac{P_{j,t}}{\phi_{j,t}Y_{j,t}}.$$

Define $B_{j,t-1} \equiv \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta} \frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}}$:

$$(1+\beta(\delta-1))B_{j,t-1}B_{j,t} - (\delta-1)\beta(\alpha+\xi)B_{j,t} \overset{!}{=} B_{j,t-1}(\alpha+\xi+\alpha\beta\delta) - \alpha\beta\delta(\alpha+\xi).$$

$$B_{j,t} \overset{!}{=} \frac{(\alpha+\xi+\alpha\beta\delta)\,B_{j,t-1} - \alpha\beta\delta(\alpha+\xi)}{(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)}. \quad \text{(A59)}$$

Note that $B_{j,t-1} \equiv \left(\frac{K_{j,t}}{K_{j,t-1}^{1-\delta}}\right)^{1/\delta} \frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}} = \Omega_{j,t-1}\frac{P_{j,t-1}}{\phi_{j,t-1}Y_{j,t-1}} \Rightarrow \Omega_{j,t-1} = B_{j,t-1}\times \frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$. Hence, $B_{j,t-1}$ gives the share of total real expenditure spent on investment in country j in period $t-1$. This share is bounded between zero and one. Note also that (A59) holds for all t. There are two steady states for (A59) where $B_{j,t} = B_{j,t-1} = B_j$, which are given by:

$$(1+\beta(\delta-1))B_j^2 - (\alpha+\xi+\alpha\beta\delta)\,B_j - (\delta-1)\beta(\alpha+\xi)B_j + \alpha\beta\delta(\alpha+\xi) \overset{!}{=} 0 \Rightarrow$$

$$B_j^2 - \frac{(\alpha+\xi+\alpha\beta\delta+\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)}{(1+\beta\delta-\beta)}B_j + \frac{\alpha\beta\delta(\alpha+\xi)}{1+\beta\delta-\beta} \overset{!}{=} 0 \Rightarrow$$

$$B_j^2 - \frac{(\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)}{(1+\beta\delta-\beta)}B_j + \frac{\alpha\beta\delta(\alpha+\xi)}{1+\beta\delta-\beta} \overset{!}{=} 0 \Rightarrow$$

$$B_j = \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm \left(\frac{(\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)^2}{4(1+\beta\delta-\beta)^2} - \frac{\alpha\beta\delta(\alpha+\xi)}{1+\beta\delta-\beta}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm \left(\frac{(\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)^2 - 4(1+\beta\delta-\beta)\alpha\beta\delta(\alpha+\xi)}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm \left(\frac{(-\alpha+\alpha\beta-\xi+\beta\xi-\beta\delta\xi-2\alpha\beta\delta)^2 - 4(1+\beta\delta-\beta)\alpha\beta\delta(\alpha+\xi)}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow$$

$$B_j = \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm \left(\frac{(-\alpha+\alpha\beta-\xi+\beta\xi-\beta\delta\xi)^2 - 4\alpha\beta\delta(-\alpha+\alpha\beta-\xi+\beta\xi-\beta\delta\xi)}{4(1+\beta\delta-\beta)^2} + \frac{(-2\alpha\beta\delta)^2 - 4(1+\beta\delta-\beta)\alpha\beta\delta(\alpha+\xi)}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow$$

$$
\begin{aligned}
B_j =& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \\
&\pm\left(\frac{(-\alpha+\alpha\beta-\xi+\beta\xi-\beta\delta\xi)^2+4\alpha^2\beta\delta-4\alpha^2\beta^2\delta+4\alpha\beta\delta\xi-4\alpha\beta^2\delta\xi+4\alpha\beta^2\delta^2\xi}{4(1+\beta\delta-\beta)^2}\right. \\
&\left.+\frac{(2\alpha\beta\delta)^2-4\alpha^2\beta\delta-4\alpha\beta\delta\xi-4\alpha^2\beta^2\delta^2-4\alpha\beta^2\delta^2\xi+4\alpha^2\beta^2\delta+4\alpha\beta^2\delta\xi}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow \\
B_j =& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm\left(\frac{(-\alpha+\alpha\beta-\xi+\beta\xi-\beta\delta\xi)^2}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow \\
B_j =& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm\left(\frac{(\alpha(\beta-1)+(\beta-1-\beta\delta)\xi)^2}{4(1+\beta\delta-\beta)^2}\right)^{1/2} \Rightarrow \\
B_j =& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{2(1+\beta\delta-\beta)} \pm \frac{\alpha(\beta-1)+(\beta-1-\beta\delta)\xi}{2(1+\beta\delta-\beta)} \Rightarrow \\
B_j =& \frac{(\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)\pm(\alpha(\beta-1)+(\beta-1-\beta\delta)\xi)}{2(1+\beta\delta-\beta)} \Rightarrow \\
B_j^- =& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi-(\alpha(\beta-1)+(\beta-1-\beta\delta)\xi)}{2(1+\beta\delta-\beta)} \\
=& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi-\alpha\beta+\alpha-\beta\xi+\xi+\beta\delta\xi}{2(1+\beta\delta-\beta)} \\
=& \frac{2\alpha+2\xi+2\alpha\beta\delta+2\beta\delta\xi-2\alpha\beta-2\beta\xi}{2(1+\beta\delta-\beta)} \\
=& \frac{\alpha+\xi+\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi}{1+\beta\delta-\beta} \\
=& \frac{(\alpha+\xi)(1+\beta\delta-\beta)}{1+\beta\delta-\beta} = \alpha+\xi. \\
B_j^+ =& \frac{(\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi)+(\alpha(\beta-1)+(\beta-1-\beta\delta)\xi)}{2(1+\beta\delta-\beta)} \\
=& \frac{\alpha+\xi+2\alpha\beta\delta+\beta\delta\xi-\alpha\beta-\beta\xi+\alpha\beta-\alpha+\beta\xi-\xi-\beta\delta\xi}{2(1+\beta\delta-\beta)} \\
=& \frac{\alpha\beta\delta}{1+\beta\delta-\beta}.
\end{aligned}
$$

Remember that $\Omega_{j,t-1} = B_{j,t-1}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$. Hence, $B_j = B_j^- = \alpha+\xi$, $(\alpha+\xi)\phi_{j,t-1}Y_{j,t-1} = P_{j,t-1}\Omega_{j,t-1}$ implies that the amount of total expenditures remaining after payments for intermediates (which is $(1-\alpha-\xi)\phi_{j,t-1}Y_{j,t-1}$) would be invested and nothing consumed. This cannot be optimal, as $\ln(0) = -\infty$. It also violates the transversality condition (see Section L.2). Alternatively, $B = B_j^+ = \frac{\alpha\beta\delta}{1+\beta\delta-\beta}$, $\Omega_{j,t-1} = \frac{\alpha\beta\delta}{(1+\beta\delta-\beta)}\frac{\phi_{j,t-1}Y_{j,t-1}}{P_{j,t-1}}$ implies that a constant share of total real expenditures is invested for all countries. It also satisfies the transversality condition (see again Section L.2).

Next, we demonstrate that $B_j^+ = \frac{\alpha\beta\delta}{1-\beta+\beta\delta}$ is an unstable equilibrium. First, we linearize equation (A59) around $B_{j,0}$:

$$B_{j,t}(B_{j,t-1}) = \frac{(\alpha+\xi+\alpha\beta\delta)\,B_{j,0} - \alpha\beta\delta(\alpha+\xi)}{(1+\beta(\delta-1))B_{j,0} - (\delta-1)\beta(\alpha+\xi)} + \frac{(\alpha+\xi)\beta[\alpha+\xi(1-\delta)]}{[(1-\beta(1-\delta))B_{j,0} + (1-\delta)\beta(\alpha+\xi)]^2}\left(B_{j,t-1} - B_{j,0}\right),$$

where we used the following expression for the partial derivative of equation (A59) with respect to $B_{j,t-1}$:

$$\begin{aligned}
\frac{\partial B_{j,t}}{\partial B_{j,t-1}} =& \frac{(\alpha+\xi+\alpha\beta\delta)\,[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
&- \frac{(1+\beta(\delta-1))\,[(\alpha+\xi+\alpha\beta\delta)\,B_{j,t-1} - \alpha\beta\delta(\alpha+\xi)]}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{-(\alpha+\xi+\alpha\beta\delta)\,(\delta-1)\beta(\alpha+\xi) + (1+\beta(\delta-1))\alpha\beta\delta(\alpha+\xi)}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{-(\delta-1)\beta(\alpha+\xi)^2 - \alpha\beta\delta(\delta-1)\beta(\alpha+\xi) + \alpha\beta\delta(\alpha+\xi) + \beta(\delta-1)\alpha\beta\delta(\alpha+\xi)}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{-(\delta-1)\beta(\alpha+\xi)^2 + \alpha\beta\delta(\alpha+\xi)}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{(\alpha+\xi)\beta[-(\delta-1)(\alpha+\xi) + \alpha\delta]}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{(\alpha+\xi)\beta[-\delta\alpha + \alpha - \delta\xi + \xi + \alpha\delta]}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{(\alpha+\xi)\beta[\alpha+\xi(1-\delta)]}{[(1+\beta(\delta-1))B_{j,t-1} - (\delta-1)\beta(\alpha+\xi)]^2} \\
=& \frac{(\alpha+\xi)\beta[\alpha+\xi(1-\delta)]}{[(1-\beta(1-\delta))B_{j,t-1} + (1-\delta)\beta(\alpha+\xi)]^2}.
\end{aligned}$$

Evaluate at point $B_{j,0} = B_j^+ = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$:

$$B_{j,t}(B_{j,t-1}) = \frac{(\alpha+\xi+\alpha\beta\delta)\,\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)} - \alpha\beta\delta(\alpha+\xi)}{(1+\beta(\delta-1))\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)} - (\delta-1)\beta(\alpha+\xi)} + \frac{(\alpha+\xi)\beta[\alpha+\xi(1-\delta)]}{[(1-\beta(1-\delta))\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)} + (1-\delta)\beta(\alpha+\xi)]^2}\left(B_{j,t-1} - \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow$$

$$
\begin{aligned}
B_{j,t}(B_{j,t-1}) = {} & \frac{\alpha\beta\delta\left(\frac{\alpha+\xi+\alpha\beta\delta}{1-\beta+\beta\delta}-(\alpha+\xi)\right)}{\alpha\beta\delta-(\delta-1)\beta(\alpha+\xi)} \\
& + \frac{(\alpha+\xi)\beta[\alpha+\xi(1-\delta)]}{[\alpha\beta\delta+(1-\delta)\beta(\alpha+\xi)]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow \\
B_{j,t}(B_{j,t-1}) = {} & \frac{\alpha\beta\delta\left(\frac{\alpha\beta\delta+\beta(\alpha+\xi)-\beta\delta(\alpha+\xi)}{1-\beta+\beta\delta}\right)}{\alpha\beta\delta-(\delta-1)\beta(\alpha+\xi)} \\
& + \frac{(\alpha+\xi)[\alpha+\xi(1-\delta)]}{\beta[\alpha\delta+(1-\delta)(\alpha+\xi)]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow \\
B_{j,t}(B_{j,t-1}) = {} & \frac{\alpha\beta\delta\left(\alpha\beta\delta+\beta(\alpha+\xi)-\beta\delta(\alpha+\xi)\right)}{\left(\alpha\beta\delta+\beta(\alpha+\xi)-\beta\delta(\alpha+\xi)\right)(1-\beta+\beta\delta)} \\
& + \frac{(\alpha+\xi)[\alpha+\xi(1-\delta)]}{\beta[\alpha\delta+\alpha-\alpha\delta+\xi(1-\delta)]^2}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right) \Rightarrow \\
B_{j,t}(B_{j,t-1}) = {} & \frac{\alpha\beta\delta}{1-\beta+\beta\delta} \\
& + \frac{(\alpha+\xi)}{\beta[\alpha+\xi(1-\delta)]}\left(B_{j,t-1}-\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\right).
\end{aligned}
$$

Note that $0 < \beta < 1$, $0 < \delta \leq 1$, $0 < \alpha < 1$ and $0 < \xi < 1$ and therefore $(\alpha\beta\delta)/(1-\beta+\beta\delta) > 0$ and $(\alpha+\xi)/\left\{\beta[\alpha+\xi(1-\delta)]\right\} > 1$. Hence, all values starting above $B^{+}_{j,t-1} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$ will converge to one. This implies that everything is invested and nothing consumed which is not optimal and violates the transversality condition. Alternatively, all values starting below $B^{+}_{j,t-1} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$, will converge to 0. This implies that nothing is invested, which is not feasible either because in this case capital stock, output, and income will all be equal to zero (see equations (A50) and (A51)). It follows that $B^{+}_{j} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$ is the *only* solution of (A59) that is consistent with the transversality condition and with positive investments and output in each period. Hence, the optimal solution requires $B_{j,t}$ to be constant along the transition path and to be equal to $\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}$. We can use this result, together with $K_{j,t+1} = \Omega^{\delta}_{j,t}K^{1-\delta}_{j,t}$ and $Y_{j,t} = p_{j,t}A_{j,t}K^{\alpha}_{j,t}L^{\xi}_{j,t}Q^{1-\alpha-\xi}_{j,t}$, to obtain the policy function for capital:

$$
\begin{aligned}
K_{j,t+1} &= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}Y_{j,t}}{P_{j,t}}\right)^{\delta}K^{1-\delta}_{j,t} \\
&= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}p_{j,t}A_{j,t}K^{\alpha}_{j,t}L^{\xi}_{j,t}Q^{1-\alpha-\xi}_{j,t}}{P_{j,t}}\right)^{\delta}K^{1-\delta}_{j,t} \\
&= \left(\frac{\alpha\beta\delta}{(1-\beta+\beta\delta)}\frac{\phi_{j,t}p_{j,t}A_{j,t}L^{\xi}_{j,t}Q^{1-\alpha-\xi}_{j,t}}{P_{j,t}}\right)^{\delta}K^{\alpha\delta+1-\delta}_{j,t}.
\end{aligned}
$$

The policy function for the capital stock with intermediates looks very similar to the one in our main system without intermediates as given in equation (16). As discussed in online Appendix C.5, the main implications are that the effects of domestic investment in our model are magnified through the appearance of intermediates, and that foreign capital now has an indirect impact on domestic output and investment that is also channeled through the new term for intermediates.

Finally, once we have pinned down the values for $K_{j,t+1}$ and $K_{j,t}$, we can determine the level of investment:

$$\begin{aligned}\Omega_{j,t} &= \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} = \left(\frac{\left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{(1-\beta+\beta\delta)P_{j,t}}\right]^{\delta}K_{j,t}^{\alpha\delta+1-\delta}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} \\ &= \left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{(1-\beta+\beta\delta)\,P_{j,t}}\right]K_{j,t}^{\alpha}.\end{aligned}$$

In addition, we can obtain the optimal level of current consumption by using the policy function for capital and reformulating $Y_{j,t} = P_{j,t}C_{j,t} + P_{j,t}\Omega_{j,t} + P_{j,t}Q_{j,t}$, i.e.:

$$\begin{aligned}C_{j,t} &= \frac{\phi_{j,t}Y_{j,t}}{P_{j,t}} - \Omega_{j,t} - Q_{j,t} \\ &= \frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}} - \left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{(1-\beta+\beta\delta)\,P_{j,t}}\right]K_{j,t}^{\alpha} \\ &\quad -(1-\alpha-\xi)\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}} \\ &= (\alpha+\xi)\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}} - \left[\frac{\alpha\beta\delta\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{(1-\beta+\beta\delta)\,P_{j,t}}\right]K_{j,t}^{\alpha} \\ &= \left[\alpha+\xi-\frac{\alpha\beta\delta}{1-\beta+\beta\delta}\right]\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}} \\ &= \left[\frac{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}{1-\beta+\beta\delta}\right]\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}}.\end{aligned}$$

Note again, that $Q_{j,t}$ can be calculated as:

$$\begin{aligned}Q_{j,t} &= (1-\alpha-\xi)\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}Q_{j,t}^{1-\alpha-\xi}}{P_{j,t}} \Rightarrow \\ Q_{j,t} &= \left[(1-\alpha-\xi)\frac{\phi_{j,t}p_{j,t}A_{j,t}K_{j,t}^{\alpha}L_{j,t}^{\xi}}{P_{j,t}}\right]^{\frac{1}{\alpha+\xi}}.\end{aligned}$$

L.2 Derivation of the Transversality Condition

This section demonstrates that our system (A49)-(A54) is a well-behaved dynamic problem and that the following transversality condition is satisfied:

$$\lim_{t\to\infty} \beta^t \frac{\partial F(x_t^*, x_{t+1}^*)}{\partial x_t} x_t^* = 0,$$

where '*' denote the solutions of the dynamic problem. To apply the transversality condition to our model with intermediates we start with the objective function:

$$\max_{\{K_{j,t}, Q_{j,t}\}} \sum_{t=0}^{\infty} \beta^t \ln \left[\phi_{j,t} p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi} / P_{j,t} - \left(K_{j,t+1} / K_{j,t}^{1-\delta} \right)^{1/\delta} - Q_{j,t} \right],$$

which is only a function of $K_{j,t}$, $K_{j,t+1}$ and $Q_{j,t}$, alongside exogenous variables for the consumer (such as $p_{j,t}$ and $P_{j,t}$) and parameters. Let:

$$F \equiv \ln \left[\phi_{j,t} p_{j,t} A_{j,t} K_{j,t}^{\alpha} L_{j,t}^{\xi} Q_{j,t}^{1-\alpha-\xi} / P_{j,t} - \left(K_{j,t+1} / K_{j,t}^{1-\delta} \right)^{1/\delta} - Q_{j,t} \right].$$

The transversality condition with respect to capital becomes:

$$\lim_{t\to\infty} \beta^t \frac{\partial F(K_{j,t}^*, K_{j,t+1}^*)}{\partial K_{j,t}} K_{j,t}^* = 0.$$

To show that the transversality condition is satisfied, we take the derivative of F with respect to $K_{j,t}$ and plug it into the transversality condition:

$$\begin{aligned}
\lim_{t\to\infty} \frac{\beta^t}{C_{j,t}^*} \left(\frac{\alpha \phi_{j,t} Y_{j,t}^*}{P_{j,t}^* K_{j,t}^*} - \frac{(\delta-1)}{\delta} \left(K_{j,t+1}^* \right)^{1/\delta} \left(K_{j,t}^* \right)^{-1/\delta} \right) K_{j,t}^* &= \\
\lim_{t\to\infty} \frac{\beta^t}{C_{j,t}^*} \left(\frac{\alpha \phi_{j,t} Y_{j,t}^*}{P_{j,t}^*} - \frac{(\delta-1)}{\delta} \left(K_{j,t+1}^* \right)^{1/\delta} \left(K_{j,t}^* \right)^{1-1/\delta} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha \phi_{j,t} Y_{j,t}^*}{C_{j,t}^* P_{j,t}^*} - \frac{(\delta-1)\Omega_{j,t}^*}{\delta C_{j,t}^*} \right)&.
\end{aligned}$$

Remembering that $\Omega^*_{j,t} = \frac{\alpha\beta\delta}{(1-\beta+\beta\delta)} \frac{\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}}$, and $C^*_{j,t} = \left[\frac{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}{(1-\beta+\beta\delta)}\right] \frac{\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}}$, we can replace $\frac{\phi_{j,t} Y^*_{j,t}}{C^*_{j,t} P^*_{j,t}}$ by $\frac{1-\beta+\beta\delta}{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}$ and $\frac{\Omega^*_{j,t}}{C^*_{j,t}}$ by $\frac{\alpha\beta\delta}{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}$ to obtain:

$$
\begin{aligned}
\lim_{t\to\infty} \beta^t \left(\frac{\alpha - \alpha\beta + \alpha\beta\delta}{(\alpha+\xi)(1-\beta+\beta\delta) - \alpha\beta\delta} - \frac{(\delta-1)\alpha\beta\delta}{\delta\left[(\alpha+\xi)(1-\beta+\beta\delta) - \alpha\beta\delta\right]} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha\delta - \alpha\beta\delta + \alpha\beta\delta^2 - \alpha\beta\delta^2 + \alpha\beta\delta}{\delta\left[(\alpha+\xi)(1-\beta+\beta\delta) - \alpha\beta\delta\right]} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha}{(\alpha+\xi)(1-\beta+\beta\delta) - \alpha\beta\delta} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha}{\alpha - \alpha\beta + \alpha\beta\delta + \xi - \beta\xi + \beta\delta\xi - \alpha\beta\delta} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha}{\alpha(1-\beta) + \xi(1-\beta) + \beta\delta\xi} \right) &= 0,
\end{aligned}
$$

where the result that the transversality condition holds follows from the theoretical constraints on the model parameters $0 < \beta < 1$, $0 < \delta \leq 1$, $0 < \alpha < 1$ and $0 < \xi < 1$.

The transversality condition with respect to intermediates can be expressed as follows:

$$
\lim_{t\to\infty} \beta^t \frac{\partial F(Q^*_{j,t})}{\partial Q_{j,t}} Q^*_{j,t} = 0.
$$

To show that the transversality condition is satisfied, we take the derivative of F with respect to $Q_{j,t}$ and plug it into the transversality condition:

$$
\begin{aligned}
\lim_{t\to\infty} \frac{\beta^t}{C^*_{j,t}} \left(\frac{(1-\alpha-\xi)\phi_{j,t} Y^*_{j,t}}{P^*_{j,t} Q^*_{j,t}} \right) Q^*_{j,t} &= \\
\lim_{t\to\infty} \beta^t \left(\frac{(1-\alpha-\xi)\phi_{j,t} Y^*_{j,t}}{C^*_{j,t} P^*_{j,t}} \right)&.
\end{aligned}
$$

Using $C^*_{j,t} = \left[\frac{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}{(1-\beta+\beta\delta)}\right] \frac{\phi_{j,t} Y^*_{j,t}}{P^*_{j,t}}$, we can replace $\frac{\phi_{j,t} Y^*_{j,t}}{C^*_{j,t} P^*_{j,t}}$ by $\frac{1-\beta+\beta\delta}{(\alpha+\xi)(1-\beta+\beta\delta)-\alpha\beta\delta}$:

$$
\begin{aligned}
\lim_{t\to\infty} \beta^t \left(\frac{(1-\alpha-\xi)(1-\beta+\beta\delta)}{(\alpha+\xi)(1-\beta+\beta\delta) - \alpha\beta\delta} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{(1-\alpha-\xi)(1-\beta+\beta\delta)}{\alpha(1-\beta) + \xi(1-\beta+\beta\delta)} \right) &= 0,
\end{aligned}
$$

where the result that the transversality condition holds follows from the theoretical constraints on the model parameters $0 < \beta < 1$, $0 < \delta \leq 1$, $0 < \alpha < 1$ and $0 < \xi < 1$.

M Iso-Elastic Utility Function

Our log-linear utility function implies an intertemporal elasticity of substitution of 1. The macro-literature often uses a value of 0.5. Empirical studies seem to support values between 0.25 and 1, cf. Sampson (2016). In order to investigate the sensitivity of our results with respect to the log-linear utility specification, we generalize our utility function to an iso-elastic one:

$$U_{j,t} = \sum_{t=0}^{\infty} \beta^t \frac{C_{j,t}^{1-\rho} - 1}{1-\rho}, \quad \rho > 0,$$

where $1/\rho$ denotes the intertemporal elasticity of substitution. Note that this utility function approaches $\ln(C_{j,t})$ for $\rho \to 1$. We retain all other assumptions of our baseline model.

Combine the budget constraint with the production function:

$$P_{j,t}C_{j,t} + P_{j,t}\Omega_{j,t} = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

Use the capital transition function to solve for $\Omega_{j,t} = \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}$ and substitute in the budget constraint:

$$P_{j,t}C_{j,t} + P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} = \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha}.$$

Set up the Lagrangian:

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \left[\frac{C_{j,t}^{1-\rho} - 1}{1-\rho} + \lambda_{j,t}\left(\phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\right)\right].$$

Differentiate with respect to $C_{j,t}$, $K_{j,t+1}$ and $\lambda_{j,t}$ to obtain the following set of first-order conditions:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial C_{j,t}} &= \beta^t C_{j,t}^{-\rho} - \beta^t \lambda_{j,t} P_{j,t} \stackrel{!}{=} 0 \quad \text{for all } j \text{ and } t. \\
\frac{\partial \mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1}\lambda_{j,t+1}\phi_{j,t+1}p_{j,t+1}A_{j,t+1}L_{j,t+1}^{1-\alpha}\alpha K_{j,t+1}^{\alpha-1} - \beta^t\lambda_{j,t}P_{j,t}\left(\frac{1}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}}\frac{1}{\delta}K_{j,t+1}^{\frac{1}{\delta}-1} \\
&\quad -\beta^{t+1}\lambda_{j,t+1}P_{j,t+1}K_{j,t+2}^{\frac{1}{\delta}}\frac{\delta-1}{\delta}K_{j,t+1}^{-\frac{1}{\delta}} \stackrel{!}{=} 0 \quad \text{for all } j \text{ and } t. \\
\frac{\partial \mathcal{L}}{\partial \lambda_{j,t}} &= \phi_{j,t}p_{j,t}A_{j,t}L_{j,t}^{1-\alpha}K_{j,t}^{\alpha} - P_{j,t}C_{j,t} - P_{j,t}\left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}}\right)^{\frac{1}{\delta}} \stackrel{!}{=} 0 \quad \text{for all } j \text{ and } t.
\end{aligned}$$

Use the first-order condition for consumption to solve for $\lambda_{j,t}$:

$$\lambda_{j,t} = \frac{C_{j,t}^{-\rho}}{P_{j,t}} \quad \text{for all } j \text{ and } t.$$

Substitute $\lambda_{j,t}$ in the first-order condition for capital:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial K_{j,t+1}} &= \beta^{t+1} \frac{C_{j,t+1}^{-\rho}}{P_{j,t+1}} \phi_{j,t+1} p_{j,t+1} A_{j,t+1} L_{j,t+1}^{1-\alpha} \alpha K_{j,t+1}^{\alpha-1} - \beta^t C_{j,t}^{-\rho} \left(\frac{1}{K_{j,t}^{1-\delta}} \right)^{\frac{1}{\delta}} \frac{1}{\delta} K_{j,t+1}^{\frac{1}{\delta}-1} \\ & \quad - \beta^{t+1} C_{j,t+1}^{-\rho} K_{j,t+2}^{\frac{1}{\delta}} \frac{\delta - 1}{\delta} K_{j,t+1}^{-\frac{1}{\delta}} \overset{!}{=} 0 \quad \text{for all } j \text{ and } t. \end{aligned}$$

Simplify and re-arrange:

$$\begin{aligned} & \frac{\beta C_{j,t+1}^{-\rho} \phi_{j,t+1} p_{j,t+1} A_{j,t+1} L_{j,t+1}^{1-\alpha} \alpha K_{j,t+1}^{\alpha-1}}{P_{j,t+1}} = \\ & C_{j,t}^{-\rho} \left(\frac{1}{K_{j,t}^{1-\delta}} \right)^{\frac{1}{\delta}} \frac{1}{\delta} K_{j,t+1}^{\frac{1}{\delta}-1} + C_{j,t+1}^{-\rho} \frac{(\delta - 1) \beta}{\delta} K_{j,t+2}^{\frac{1}{\delta}} K_{j,t+1}^{-\frac{1}{\delta}} \quad \text{for all } j \text{ and } t. \end{aligned}$$

Use the definition of $Y_{j,t}$ and simplify further:

$$\frac{\alpha \beta C_{j,t+1}^{-\rho} \phi_{j,t+1} Y_{j,t+1}}{K_{j,t+1} P_{j,t+1}} = \frac{C_{j,t}^{-\rho}}{\delta} \frac{K_{j,t+1}^{\frac{1}{\delta}-1}}{K_{j,t}^{\frac{1-\delta}{\delta}}} + \frac{\beta (\delta - 1) C_{j,t+1}^{-\rho}}{\delta} \left(\frac{K_{j,t+2}}{K_{j,t+1}} \right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t.$$

This is the standard consumption Euler equation. Note that we have four forward-looking variables for each country: $Y_{j,t}$, $K_{j,t}$, $C_{j,t}$ and $P_{j,t}$. Hence, overall we have $4N$ forward-looking variables in our system here. These are, alongside $\Pi_{j,t}$, the endogenous variables we have to solve for.

To check whether the transversality condition to the model with the iso-elastic utility function is satisfied, we start with the following objective function:

$$\max_{\{K_{j,t}\}} \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\rho} \left\{ \left[\left(\phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha} \right) / P_{j,t} - \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}} \right)^{\frac{1}{\delta}} \right]^{1-\rho} - 1 \right\},$$

which is only a function of $K_{j,t}$ and $K_{j,t+1}$ alongside exogenous variables for the consumer (such as $p_{j,t}$ and $P_{j,t}$). Let:

$$F \equiv \frac{1}{1-\rho} \left\{ \left[\left(\phi_{j,t} p_{j,t} A_{j,t} L_{j,t}^{1-\alpha} K_{j,t}^{\alpha} \right) / P_{j,t} - \left(\frac{K_{j,t+1}}{K_{j,t}^{1-\delta}} \right)^{\frac{1}{\delta}} \right]^{1-\rho} - 1 \right\},$$

and define the transversality condition:

$$\lim_{t\to\infty} \beta^t \frac{\partial F(K^*_{j,t}, K^*_{j,t+1})}{\partial K_{j,t}} K^*_{j,t} = 0.$$

To show that the transversality condition is satisfied, differentiate F with respect to $K_{j,t}$ and plug it into the transversality condition:

$$\begin{aligned}
\lim_{t\to\infty} \frac{\beta^t}{\left(C^*_{j,t}\right)^\rho} \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{P^*_{j,t} K^*_{j,t}} - \frac{(\delta-1)}{\delta} \left(K^*_{j,t+1}\right)^{1/\delta} \left(K^*_{j,t}\right)^{-1/\delta} \right) K^*_{j,t} &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{\left(C^*_{j,t}\right)^\rho P^*_{j,t}} - \frac{(\delta-1)}{\delta\left(C^*_{j,t}\right)^\rho} \left(K^*_{j,t+1}\right)^{1/\delta} \left(K^*_{j,t}\right)^{1-1/\delta} \right) &= \\
\lim_{t\to\infty} \beta^t \left(\frac{\alpha\phi_{j,t} Y^*_{j,t}}{\left(C^*_{j,t}\right)^\rho P^*_{j,t}} - \frac{(\delta-1)\Omega^*_{j,t}}{\delta\left(C^*_{j,t}\right)^\rho} \right) &= 0,
\end{aligned}$$

which holds as all endogenously variables converge to the long-run steady state when $t \to \infty$ and $\beta < 1$.

Similar to the case with linear capital accumulation, there is no analytical solution in the case with iso-elastic utility. Therefore, we solve our model by feeding Dynare the following system of equations:

$$\begin{aligned}
Y_{j,t} &= \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j P_{j,t}} A_{j,t} L^{1-\alpha}_{j,t} K^\alpha_{j,t} \quad \text{for all } j \text{ and } t, \\
Y_t &= \sum_j Y_{j,t} \quad \text{for all } t, \\
Y_{j,t} &= P_{j,t} C_{j,t} + P_{j,t} \left(\frac{K_{j,t+1}}{K^{1-\delta}_{j,t}} \right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t, \\
P_{j,t} &= \left[\sum_i \left(\frac{t_{ij,t}}{P_{i,t}} \right)^{1-\sigma} \frac{Y_{i,t}}{Y_t} \right]^{\frac{1}{1-\sigma}} \quad \text{for all } j \text{ and } t, \\
\Pi_{i,t} &= \left[\sum_j \left(\frac{t_{ij,t}}{P_{j,t}} \right)^{1-\sigma} \frac{\phi_{j,t} Y_{j,t}}{Y_t} \right]^{\frac{1}{1-\sigma}} \quad \text{for all } i \text{ and } t, \\
\frac{\alpha\beta C^{-\rho}_{j,t+1} \phi_{j,t+1} Y_{j,t+1}}{K_{j,t+1} P_{j,t+1}} &= \frac{C^{-\rho}_{j,t}}{\delta} \frac{K^{\frac{1}{\delta}-1}_{j,t+1}}{K^{\frac{1-\delta}{\delta}}_{j,t}} + \frac{\beta(\delta-1) C^{-\rho}_{j,t+1}}{\delta} \left(\frac{K_{j,t+2}}{K_{j,t+1}} \right)^{\frac{1}{\delta}} \quad \text{for all } j \text{ and } t. \qquad \text{(A60)}
\end{aligned}$$

The first equation is the production function from equation (24), where we have replaced $p_{j,t}$ using equation (23). The second equation is the definition of world GDP. The third equation is the budget constraint, where we use equation (2) to replace $\Omega_{j,t}$. The fourth and fifth equations are the MRs as given by equations (21) and (22), respectively. Finally, the last equation is the Euler equation just derived above. Note that equation (A60) only gives a relationship for determining the capital stocks, it is no longer an analytical expression for next period capital stocks, but rather the consumption Euler equation.

What does this new system imply for our results?

1. Concerning the empirical specification, we see that the trade cost estimates and the *Income equation* estimates do not change at all. Hence, trade costs, α and σ would be estimated as we did so far. However, as in the case with a linear transition function for capital, we no longer have a closed-form solution for our policy function. We therefore cannot derive an estimable *Capital equation*. Hence, we are no longer able to back out the depreciation rate δ and test for causal effects of trade on capital accumulation.

2. To study the implications for the steady state consider equation (A60):

$$
\begin{aligned}
\frac{\alpha\beta C_j^{-\rho}\phi_j Y_j}{K_j P_j} &= \frac{C_j^{-\rho}}{\delta}\frac{K_j^{\frac{1}{\delta}-1}}{K_j^{\frac{1-\delta}{\delta}}} + \frac{\beta\left(\delta-1\right)C_j^{-\rho}}{\delta}\left(\frac{K_j}{K_j}\right)^{\frac{1}{\delta}} \Rightarrow \\
\frac{\alpha\beta\phi_j Y_j}{K_j P_j} &= \frac{1}{\delta} + \frac{\beta\left(\delta-1\right)}{\delta} \Rightarrow \\
K_j &= \frac{\delta}{1+\beta\left(\delta-1\right)}\frac{\alpha\beta\phi_j Y_j}{P_j} \Rightarrow \\
K_j &= \frac{\alpha\beta\delta\phi_j Y_j}{(1-\beta+\beta\delta)P_j}.
\end{aligned}
$$

   Given this solution for the steady-state capital stock, which is again a function of parameters and Y_j/P_j, all our analytical insights from Section 3.1 go through. Actually, the expression for the steady-state capital stock is identical to our expression for the steady-state capital stock in our baseline setting.

   The expression for consumption in steady state with iso-elastic utility is also identical to the corresponding expression that we obtained with the log-linear intertemporal utility function:

$$
\begin{aligned}
C_j &= \frac{\phi_j Y_j}{P_j} - K_j = \frac{\phi_j Y_j}{P_j} - \frac{\alpha\beta\delta\phi_j Y_j}{\left(1-\beta+\beta\delta\right)P_j} = \\
&= \left[\frac{1-\beta+\beta\delta-\alpha\beta\delta}{1-\beta+\beta\delta}\right]\frac{\phi_j Y_j}{P_j}.
\end{aligned}
$$

3. For our counterfactuals, we have to back out A_j/γ_j. This can be done in the exact same fashion as in the case with the log-linear intertemporal utility function, given that we can determine the steady-state capital stock.

Finally, concerning welfare, we have to use the iso-elastic utility function. This changes our

Lucas discount formula as follows:

$$\begin{aligned}
\sum_{t=0}^{\infty}\beta^t\frac{\left(C^c_{j,t}\right)^{1-\rho}-1}{1-\rho} &= \sum_{t=0}^{\infty}\beta^t\frac{\left[\left(1+\frac{\zeta}{100}\right)C^b_{j,t}\right]^{1-\rho}-1}{1-\rho} \Rightarrow \\
\sum_{t=0}^{\infty}\beta^t\left(C^c_{j,t}\right)^{1-\rho} &= \sum_{t=0}^{\infty}\beta^t\left[\left(1+\frac{\zeta}{100}\right)C^b_{j,t}\right]^{1-\rho} \Rightarrow \\
\left(1+\frac{\zeta}{100}\right)^{1-\rho} &= \frac{\sum_{t=0}^{\infty}\beta^t\left(C^c_{j,t}\right)^{1-\rho}}{\sum_{t=0}^{\infty}\beta^t\left(C^b_{j,t}\right)^{1-\rho}} \Rightarrow \\
\zeta &= \left[\left(\frac{\sum_{t=0}^{\infty}\beta^t\left(C^c_{j,t}\right)^{1-\rho}}{\sum_{t=0}^{\infty}\beta^t\left(C^b_{j,t}\right)^{1-\rho}}\right)^{\frac{1}{1-\rho}}-1\right]\times 100.
\end{aligned}$$

Taking all of the above considerations into account, in section C.6 of this appendix we study the empirical consequences of replacing the log-linear intertemporal utility function with an iso-elastic one.

References

Acemoglu, Daron, *Introduction to Modern Economic Growth*, Princeton University Press, 2009.

Adjemian, Stéphane, Houtan Bastani, Michel Juillard, Frédéric Karamé, Junior Maih, Ferhat Mihoubi, George Perendia, Johannes Pfeifer, Marco Ratto, and Sébastien Villemot, "Dynare: Reference Manual, Version 4," *Dynare Working Papers, 1.*, 2011.

Agnosteva, Delina E., James E. Anderson, and Yoto V. Yotov, "Intra-national Trade Costs: Measurement and Aggregation," *NBER Working Paper No. 19872*, 2014.

Ali, S. and U. Dadush, "Trade in Intermediates and Economic Policy," *VoxEU*, 2011.

Anderson, James E. and Yoto V. Yotov, "Terms of Trade and Global Efficiency Effects of Free Trade Agreements, 1990-2002," *Journal of International Economics*, 2016, *99* (C), 279–298.

Brown, Drusilla K., Alan V. Deardorff, and Robert M. Stern, "A North American Free Trade Agreement: Analytical Issues and A Computational Assessment," *The World Economy*, 1992, *15*, 11–30.

_ , _ , and _ , "North American Integration," *Economic Journal*, 1992, *102* (415), 1507–1518.

Caliendo, Lorenzo and Fernando Parro, "Estimates of the Trade and Welfare Effects of NAFTA," *Review of Economic Studies*, 2015, *82* (1), 1–44.

Dekle, Robert, Jonathan Eaton, and Samuel Kortum, "Unbalanced Trade," *American Economic Review: Papers and Proceedings*, 2007, *97* (2), 351–355.

_ , _ , and _ , "Global Rebalancing with Gravity: Measuring the Burden of Adjustment," *IMF Staff Papers*, June 2008, *55* (3), 511–540.

Eaton, Jonathan and Samuel Kortum, "Technology, Geography and Trade," *Econometrica*, 2002, *70* (5), 1741–1779.

_ , _ , B. Neiman, and J. Romalis, "Trade and the Global Recession," *American Economic Review*, forthcoming, 2016.

Fox, Alan K., "Evaluating the Success of a CGE Model of the Canada-U.S. Free Trade Agreement," *Manuscript*, 1999.

Grossman, Gene M. and Esteban Rossi-Hansberg, "Task Trade between Similar Countries," *Econometrica*, 2012, *80* (2), 593–629.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse, Toolkit, and Cookbook," Chapter 3 in the Handbook of International Economics Vol. 4, eds. Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogoff, Elsevier Ltd., Oxford, 2014, pp. 131–195.

Heer, Burkhard and Alfred Maußner, *Dynamic General Equilibrium Modeling: Computational Methods and Applications*, 2 ed., Berlin: Springer, 2009.

Hercowitz, Zvi and Michael Sampson, "Output Growth, the Real Wage, and Employment Fluctuations," *American Economic Review*, 1991, *81* (5), 1215–1237.

Johnson, Robert C. and Guillermo Noguera, "Accounting for Intermediates: Production Sharing and Trade in Value Added," *Journal of International Economics*, 2012, *86* (2), 224–236.

Kehoe, Timothy J., "An Evaluation of the Performance of Applied General Equilibrium Models of the Impact of NAFTA," *Federal Reserved Bank of Minneapolis Working Paper No. 320*, 2003.

Klein, Lawrence R. and Dominick Salvatore, "Welfare Effects of the North American Free Trade Agreement," *Journal of Policy Modeling*, 1995, *17* (2), 163–176.

Kraemer, Kenneth and Jason Dedrick, "Dell Computer: Organization of a Global Production Network," *Manuscript*, 2002.

Krueger, A., "Trade Creation and Trade Diversion Under NAFTA," *NBER WP 7429*, 1999.

Lederman, Daniel, William F. Maloney, and Luis Servén, *Lessons from NAFTA for Latin America and the Caribbean*, Palo Alto, California and Washington, DC.: Stanford University Press and the World Bank, Latin American Development Forum Series, 2005.

McCleery, R., "An Intertemporal Linked Macroeconomic CGE Model of the United States and Mexico Focussing on Demographic Change and Factor Flows," in Economy-Wide Modeling of the Economic Implications of a FTA with Mexico and a NAFTA with Canada and Mexico, eds. J. Francois and C. Shiells, 1992.

Ottaviano, G., "European Integration and the Gains from Trade," *Handbook of the Economics of European Integration, eds. H. Badinger and V. Nitsch, Routledge*, 2015, Chapter 12, pp. 173–187.

Rolleigh, Michael M., "Plant Heterogeneity and Applied General Equilibrium Models of Trade: Lessons from the Canada-US Free Trade Agreement," *Manuscript*, 2013.

Romalis, John, "NAFTA's and CUSTFA's Impact on International Trade," *Review of Economics and Statistics*, 2007, *89* (3), 416–435.

Sampson, Thomas, "Dynamic Selection: An Idea Flows Theory of Entry, Trade and Growth," *Quarterly Journal of Economics*, 2016, *131* (1), 315–380.

Shikher, Serge, "Predicting the Effects of NAFTA: Now We Can Do It Better!," *Journal of International and Global Economic Studies*, 2012, *5* (2), 32–59.

Stokey, Nancy L., Robert E. Lucas, and Edward C. Prescott, *Recursive Methods in Economic Dynamics*, Harvard University Press Cambridge, Massachusetts, 1989.

Trefler, Daniel, "The Long and Short of the Canada-U.S. Free Trade Agreement," *American Economic Review*, 2004, *94* (4), 870–895.

Varian, Hal R., "An iPod Has Global Value. Ask the (Many) Countries That Make It," *The New York Times (June 28, 2007)*, 2007.