Online Appendix

"International Trade and Intertemporal Substitution"

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1 Baseline and Static Models

In this section, we report additional findings corresponding to the baseline and static model examined throughout the paper. Tables 1-3 report the parameterizations underlying the results examined throughout the paper.[1] Table 4 reports the price and income elasticities implied by these economies. Table 5 reports the implications of these models for additional business cycle moments discussed in the literature and not reported in the paper. Table 6 reports the implications of these models for real exchange rate dynamics.

1.1 Parameterization

A. Predetermined Parameters

Parameter		*Baseline*	*Static*
Intertemporal elasticity of substitution	$1/\gamma$	0.50	0.50
Share of consumption in utility	μ	0.34	0.34
Share of capital in production	θ	0.36	0.36
Depreciation rate	δ	0.025	0.025
Share of imports that arrive today	φ	0.63	1.00

Table 1: Baseline and Static Models – Predetermined Parameters

B. Estimated Parameters

Parameter		*Baseline*	*Static*
Elasticity of substitution	σ	1.300	1.300
Capital adjustment cost	η_k	2.114	1.420
Bond adjustment cost	η_b	0.860	0.562
Trade cost	τ	52.367	54.784
Discount factor	β	0.972	0.974
Surplus consumption autocorrelation	ρ_s	0.635	0.941
S.S. surplus consumption	$\bar{s}$	0.00035	0.00162
Moment	*Data*	*Baseline*	*Static*
Empirical price elasticity	-0.301	-0.304	-1.300
Std. Dev. Investment / Std. Dev. GDP	3.117	3.061	3.099
Std. Dev. NX/GDP	1.111	1.099	1.098
Imports / Absorption	0.231	0.231	0.231
Avg. Realized SDF	0.988	0.999	0.999
Std. Dev. Realized SDF	0.247	0.253	0.246
corr(Realized SDF, Absorption)	0.088	0.090	0.086

Table 2: Baseline and Static Models – Estimated Parameters

[1] We estimate the static model keeping the elasticity of substitution σ unchanged at its baseline value (1.30). Thus, we do not target the empirical price elasticity when estimating the static model.

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*Baseline*	*Static*	*Moment*	*Data*	*Baseline*	*Static*
$\rho_{z,z}$	0.66	0.641	$\text{corr}(A_t, A_{t-1})$	0.878	0.981	0.981
ρ_{z,p_y}	-0.34	-0.319	$\text{corr}(A_t, p_{y,t-1})$	-0.270	-0.288	-0.265
ρ_{z,p_x}	-0.69	-0.686	$\text{corr}(A_t, p_{A,t-1})$	-0.597	-0.574	-0.574
$\rho_{p_y,z}$	0.31	0.309	$\text{corr}(p_{y,t}, A_{t-1})$	0.006	0.006	0.007
ρ_{p_y,p_y}	0.99	0.989	$\text{corr}(p_{y,t}, p_{y,t-1})$	0.911	0.963	0.951
ρ_{p_y,p_x}	0.0014	0.000	$\text{corr}(p_{y,t}, p_{A,t-1})$	0.213	0.208	0.230
$\rho_{p_x,z}$	-0.03	-0.020	$\text{corr}(p_{A,t}, A_{t-1})$	-0.506	-0.507	-0.498
ρ_{p_x,p_y}	0.09	0.082	$\text{corr}(p_{A,t}, p_{y,t-1})$	0.619	0.656	0.645
ρ_{p_x,p_x}	0.993	0.99016	$\text{corr}(p_{A,t}, p_{A,t-1})$	0.902	0.954	0.943
Std. dev. ν_z	0.0029	0.0016	Std. dev. (A_t)	0.023	0.020	0.023
Std. dev. ν_y	0.0023	0.0049	Std. dev. $(p_{y,t})$	0.031	0.026	0.030
Std. dev. ν_x	0.0012	0.0020	Std. dev. $(p_{A,t})$	0.009	0.008	0.009
$\text{corr}(\nu_z, \nu_{p_y})$	0.041	-0.0015	$\text{corr}(A_t, p_{y,t})$	-0.142	-0.148	-0.143
$\text{corr}(\nu_z, \nu_{p_x})$	-0.995	-0.9993	$\text{corr}(A_t, p_{A,t})$	-0.598	-0.564	-0.562
$\text{corr}(\nu_{p_y}, \nu_{p_x})$	0.055	0.0386	$\text{corr}(p_{y,t}, p_{A,t})$	0.431	0.451	0.466

Table 3: Baseline and Static Models – Estimated Parameters

1.2 Results

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Time-to-Ship Model, Baseline	-0.304	1.249
No Time-to-Ship Model	-1.300	1.000

Table 4: Baseline and Static Models – Import Elasticities

	Data	*Baseline*	*Static*
σ(GDP)	1.982	2.800	3.097
σ(C)/σ(GDP)	0.998	0.325	0.348
corr(GDP$_t$,GDP$_{t-1}$)	0.817	0.972	0.976
corr(GDP$_t$,C$_t$)	0.750	0.551	0.592
corr(GDP$_t$,I$_t$)	0.848	0.967	0.957
corr(GDP$_t$,NX$_t$/GDP$_t$)	-0.091	0.760	0.721
σ(TOT)	1.875	3.086	3.453
corr(TOT$_t$,TOT$_{t-1}$)	0.803	0.964	0.955
corr(TOT$_t$,NX$_t$/GDP$_t$)	0.060	0.375	0.485
corr(TOT$_t$,GDP$_t$)	-0.023	0.174	0.211

Table 5: Baseline and Static Models – Other Business Cycle Moments

	Data	*Baseline*	*Static*
Std. dev. RER	3.886	3.031	2.655
corr(RER_t,RER_{t-1})	0.813	0.963	0.955
corr(RER_t,GDP_t)	0.354	0.271	0.211
corr(RER_t,NX_t/GDP_t)	0.145	0.485	0.485

Note: Real exchange rate computed as p_y/P_t, where P_t is the absorption price index.

Table 6: Baseline and Static Models – Real exchange rate dynamics

1.3 Estimates of Extended Import Demand Specifications

In this section, we estimate the empirical price and income elasticities under alternative specifications and contrast them with their model-counterparts. As in the paper, we also control for durable goods and inventories. The results are reported in Table 7.

First, we extend the estimated specification to control for the realized SDF (second row of the table). Then, we extend it to control for the realized returns to a risk-free bond (in the data, we measure it as the realized return to a 90-day U.S. government bond); see the estimation results in the third row of this table. We also report the income and price elasticities implied by our model when controlling for the expected SDF and for the expected real bond returns; see the fourth and fifth rows of the table.

Finally, we recompute the empirical and model-implied price and income elasticities using an alternative specification of the import demand equation featuring domestic absorption instead of aggregate absorption (for both quantities and prices).

	Data		*Model*	
	Price Elasticity	*Income Elasticity*	*Price Elasticity*	*Income Elasticity*
Baseline	-0.301	1.627	-0.304	1.249
Control for realized SDF	-0.298	1.613	-0.307	1.247
Control for realized real return to bond	-0.294	1.622	-0.354	1.172
Control for expected SDF	–	–	-1.086	1.005
Control for expected real return to bond	–	–	-0.408	1.101
Domestic absorption	-0.132	1.223	-0.326	1.320

Table 7: Extended Import Demand Equation

2 No Habits and Alternative Stochastic Process

In this section, we investigate two alternative parameterizations of the baseline model.

First, we consider an economy without habits such as the one studied in Section 7 of the paper. However, in contrast to the economy discussed in the paper, here we recalibrate the economy without habits according to the approach discussed in Section 5 of the paper, except that we do not target the SDF moments and we keep the elasticity of substitution σ predetermined at its baseline value (1.30).

Second, we consider an economy that can account for all target moments except for the joint dynamics of absorption and prices; this is the "alternative stochastic process" economy examined in Section 7 of the paper. We estimate the parameters of this economy following the same approach described in Section 5 of the paper, except for two differences. First, we do not target the joint dynamics of absorption and prices. Second, we target a unit income elasticity and a price elasticity equal to σ (which we keep predetermined at its baseline value, 1.30). We show that this economy implies income and price elasticities close to those of the static model. As discussed in more detail in the paper, this finding shows that estimating the stochastic process to match the joint dynamics of absorption and prices observed in U.S. is important for the findings reported in the paper.

The tables in the following subsections report the results. Tables 8-10 report the parameterizations of these economies. Table 11 reports the price and income elasticities implied by these economies.

2.1 Parameterization

A. Predetermined Parameters

Parameter		*No Habits*	*Alt. VAR*
Intertemporal elasticity of substitution	$1/\gamma$	0.50	0.50
Share of consumption in utility	μ	0.34	0.34
Share of capital in production	θ	0.36	0.36
Depreciation rate	δ	0.025	0.025
Elasticity of substitution	σ	1.32	1.32
Share of imports that arrive today	φ	0.63	0.63

Note: σ is predetermined at its baseline value (1.32).

Table 8: Habits and VAR Process – Predetermined Parameters

B. Estimated Parameters

Parameter		*No Habits*	*Alt. VAR*
Capital adjustment cost	η_k	0.076	0.068
Bond adjustment cost	η_b	0.139	0.110
Trade cost	τ	52.451	50.277
Discount factor	β	0.973	0.947
Surplus consumption autocorrelation	ρ_s	—	0.888
S.S. surplus consumption	$\bar{s}$	—	0.006
Moment	*Data*	*No Habits*	*Alt. VAR*
Std. Dev. Investment / Std. Dev. GDP	3.117	3.103	3.117
Std. Dev. NX/GDP	1.111	1.108	1.111
Imports / Absorption	0.231	0.231	0.234
Avg. Realized SDF	0.988	0.973	0.988
Std. Dev. Realized SDF	0.247	0.004	0.247
corr(Realized SDF, Absorption)	0.088	-0.108	0.088

Table 9: Habits and VAR Process – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*No Habits*	*Alt. VAR*	*Moment*	*Data*	*No Habits*	*Alt. VAR*
$\rho_{z,z}$	0.748	0.507	$\text{corr}(A_t, A_{t-1})$	0.878	0.939	0.991
ρ_{z,p_y}	-0.219	-0.058	$\text{corr}(A_t, p_{y,t-1})$	-0.270	-0.255	0.268
ρ_{z,p_x}	-0.784	-0.469	$\text{corr}(A_t, p_{A,t-1})$	-0.597	-0.833	-0.581
$\rho_{p_y,z}$	0.232	0.274	$\text{corr}(p_{y,t}, A_{t-1})$	0.006	0.007	0.345
ρ_{p_y,p_y}	0.857	0.925	$\text{corr}(p_{y,t}, p_{y,t-1})$	0.911	0.936	0.997
ρ_{p_y,p_x}	-0.001	0.000	$\text{corr}(p_{y,t}, p_{A,t-1})$	0.213	0.252	-0.197
$\rho_{p_x,z}$	0.018	-0.033	$\text{corr}(p_{A,t}, A_{t-1})$	-0.506	-0.581	-0.491
ρ_{p_x,p_y}	0.039	0.026	$\text{corr}(p_{A,t}, p_{y,t-1})$	0.619	0.475	-0.069
ρ_{p_x,p_x}	0.963	1.000	$\text{corr}(p_{A,t}, p_{A,t-1})$	0.902	0.869	0.941
Std. dev. ν_z	0.0000	0.0002	Std. dev. (A_t)	0.023	0.027	0.050
Std. dev. ν_y	0.010	0.007	Std. dev. $(p_{y,t})$	0.031	0.025	0.183
Std. dev. ν_x	0.005	0.020	Std. dev. $(p_{A,t})$	0.009	0.008	0.047
$\text{corr}(\nu_z, \nu_{p_y})$	0.961	-0.005	$\text{corr}(A_t, p_{y,t})$	-0.142	-0.162	0.306
$\text{corr}(\nu_z, \nu_{p_x})$	0.097	-0.991	$\text{corr}(A_t, p_{A,t})$	-0.598	-0.753	-0.550
$\text{corr}(\nu_{p_y}, \nu_{p_x})$	-0.185	-0.117	$\text{corr}(p_{y,t}, p_{A,t})$	0.431	0.402	-0.132

Table 10: Habits and VAR Process – Estimated Parameters

2.2 Results

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
No Habits	-1.353	1.011
Alt. VAR Process	-1.297	1.001

Table 11: Habits and VAR Process – Import Elasticities

3 Alternative Shipping Technologies

In this section, we investigate the implications of our model under alternative shipping technologies. To do so, we consider three alternative values of $\varphi = \{0.80, 0.40, 0.00\}$ and then re-estimate the model according to the approach discussed in Section 5 of the paper. The tables in the following subsections report the results. Tables 12-14 report the parameterizations of these economies. Table 15 reports the price and income elasticities implied by these economies.

3.1 Parameterization

A. Predetermined Parameters

Parameter		*(1)*	*(2)*	*(3)*
Intertemporal elasticity of substitution	$1/\gamma$	0.50	0.50	0.50
Share of consumption in utility	μ	0.34	0.34	0.34
Share of capital in production	θ	0.36	0.36	0.36
Depreciation rate	δ	0.025	0.025	0.025
Share of imports that arrive today	φ	0.80	0.40	0.00

Table 12: Shipping Technology – Predetermined Parameters

B. Estimated Parameters

Parameter		*(1)*	*(2)*	*(3)*
Elasticity of substitution	σ	1.160	1.332	1.418
Capital adjustment cost	η_k	0.595	1.476	1.009
Bond adjustment cost	η_b	1.411	0.591	0.451
Trade cost	τ	1795.233	35.355	16.616
Discount factor	β	0.972	0.976	0.980
Surplus consumption autocorrelation	ρ_s	0.889	0.694	0.709
S.S. surplus consumption	$\bar{s}$	0.00106	0.00039	0.00031
Moment	*Data*	*(1)*	*(2)*	*(3)*
Empirical Price Elasticity	-0.301	-0.304	-0.301	-0.301
Std. Dev. Investment / Std. Dev. GDP	3.117	3.110	3.117	3.118
Std. Dev. NX/GDP	1.111	1.111	1.111	1.111
Imports / Absorption	0.231	0.231	0.232	0.232
Avg. Realized SDF	0.988	0.999	1.001	1.011
Std. Dev. Realized SDF	0.247	0.255	0.247	0.246
corr(Realized SDF, Absorption)	0.088	0.090	0.088	0.087

Table 13: Shipping Technology – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*(1)*	*(2)*	*(3)*	*Moment*	*Data*	*(1)*	*(2)*	*(3)*
$\rho_{z,z}$	0.615	0.639	0.522	$\text{corr}(A_t, A_{t-1})$	0.878	0.982	0.976	0.947
ρ_{z,p_y}	-0.542	-0.331	-0.323	$\text{corr}(A_t, p_{y,t-1})$	-0.270	-0.300	-0.276	-0.271
ρ_{z,p_x}	-0.700	-0.753	-0.799	$\text{corr}(A_t, p_{A,t-1})$	-0.597	-0.580	-0.587	-0.570
$\rho_{p_y,z}$	0.116	0.301	0.296	$\text{corr}(p_{y,t}, A_{t-1})$	0.006	0.006	0.006	0.006
ρ_{p_y,p_y}	0.999	0.980	0.966	$\text{corr}(p_{y,t}, p_{y,t-1})$	0.911	0.959	0.969	0.964
ρ_{p_y,p_x}	-0.180	0.007	0.000	$\text{corr}(p_{y,t}, p_{A,t-1})$	0.213	0.209	0.215	0.217
$\rho_{p_x,z}$	-0.036	-0.023	-0.013	$\text{corr}(p_{A,t}, A_{t-1})$	-0.506	-0.499	-0.514	-0.511
ρ_{p_x,p_y}	0.136	0.074	0.069	$\text{corr}(p_{A,t}, p_{y,t-1})$	0.619	0.668	0.607	0.587
ρ_{p_x,p_x}	0.86577	0.99846	0.99967	$\text{corr}(p_{A,t}, p_{A,t-1})$	0.902	0.934	0.927	0.891
Std. dev. ν_z	0.0000002	0.0055	0.0139	Std. dev. (A_t)	0.023	0.023	0.023	0.023
Std. dev. ν_y	0.0016	0.0029	0.0032	Std. dev. $(p_{y,t})$	0.031	0.017	0.031	0.031
Std. dev. ν_x	0.0022	0.0031	0.0042	Std. dev. $(p_{A,t})$	0.009	0.008	0.009	0.009
$\text{corr}(\nu_z, \nu_{p_y})$	0.7276	0.0382	-0.0339	$\text{corr}(A_t, p_{y,t})$	-0.142	-0.155	-0.142	-0.144
$\text{corr}(\nu_z, \nu_{p_x})$	-0.6859	-0.9979	-0.9792	$\text{corr}(A_t, p_{A,t})$	-0.598	-0.561	-0.585	-0.607
$\text{corr}(\nu_{p_y}, \nu_{p_x})$	0.000005	0.0266	-0.1101	$\text{corr}(p_{y,t}, p_{A,t})$	0.431	0.461	0.431	0.431

Table 14: Shipping Technology – Estimated Parameters

3.2 Results

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
(1) $\varphi = 0.8$	-0.304	1.035
(2) $\varphi = 0.4$	-0.301	1.290
(3) $\varphi = 0.0$	-0.301	1.415

Table 15: Shipping Technology – Import Elasticities

4 Alternative Payment Technologies

In this section, we investigate the implications of our model under alternative payment technologies. To do so, we first extend the model to feature a richer set of payment technologies. In particular, we consider an extension of the model that allows for a fraction ψ of imports ordered in a given period to be paid in the same period; in the baseline model, we assume that $\psi = 1$. Then, we consider two alternative parameterizations of the payment technologies. We re-estimate the model following the approach discussed in Section 5 of the paper under $\psi = \{0.80, 0.40\}$, while keeping the shipping technology at its baseline value ($\varphi = 0.63$). The tables in the following subsections report the results. Tables 16-18 report the parameterizations of these economies. Table 19 reports the price and income elasticities implied by these economies.

4.1 Model with Alternative Payment Technologies

We extend the model such that a fraction ψ of the imports ordered in period t are paid in period t, while the remaining share $1-\psi$ of the imports ordered in t are paid in period $t+1$. We adjust the problem of final good producers (the importers) accordingly:

$$\max_{\{x_t, y_{t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \left[\beta^t \lambda_t\right] \left[p_t G(x_t, \widetilde{y}_t) - p_{x,t} x_t - (1-\psi)\tau p_{y,t-1} y_t - \psi \tau p_{y,t} y_{t+1}\right] \right\}$$

subject to

$$G(x_t, \widetilde{y}_t) = \left[x_t^{\rho} + \widetilde{y}_t^{\rho}\right]^{\frac{1}{\rho}}$$

$$\widetilde{y}_t = (1-\varphi) y_t + \varphi y_{t+1}$$

We also assume that domestic good producers (the exporters) are paid by importers in the rest of the world according to this technology. To do so, we assume that domestic good producers take as given the equilibrium share of their production that is exported in every period and state of the world, and get paid a fraction ψ of their period-t exports in the same period, and a fraction $1-\psi$ of them in the following period. Then, the problem of domestic good producers is given by:

$$\max_{k_{d,t}, n_{d,t}} \left\{ \frac{x_t}{x_t + \tau x_{t+1}^*} + \frac{\psi \tau x_{t+1}^*}{x_t + \tau x_{t+1}^*} \right\} p_{x,t} z_t k_{d,t}^{\theta} n_{d,t}^{1-\theta} - p_t w_t n_{d,t} - p_t r_{k,t} k_{d,t} + \beta \mathbb{E}_0 \left[\frac{\lambda_{t+1}}{\lambda_t} \left(\frac{(1-\psi)\tau x_{t+1}^*}{x_t + \tau x_{t+1}^*} \right) \right] p_{x,t} z_t k_{d,t}^{\theta} n_{d,t}^{1-\theta}$$

4.2 Parameterization

A. Predetermined Parameters

Parameter		*(1)*	*(2)*
Intertemporal elasticity of substitution	$1/\gamma$	0.50	0.50
Share of consumption in utility	μ	0.34	0.34
Share of capital in production	θ	0.36	0.36
Depreciation rate	δ	0.025	0.025
Share of imports that arrive today	φ	***0.63***	***0.63***
Share of imports paid today	ψ	***0.80***	***0.40***

Table 16: Payment Technology – Predetermined Parameters

B. Estimated Parameters

Parameter		*(1)*	*(2)*
Elasticity of substitution	σ	1.178	1.326
Capital adjustment cost	η_k	0.741	1.000
Bond adjustment cost	η_b	1.271	1.736
Trade cost	τ	798.651	39.518
Discount factor	β	0.976	0.991
Surplus consumption autocorrelation	ρ_s	0.947	1.000
S.S. surplus consumption	$\bar{s}$	0.00215	0.00254
Moment	*Data*	*(1)*	*(2)*
Empirical Price Elasticity	-0.301	-0.306	-0.307
Std. Dev. Investment / Std. Dev. GDP	3.117	3.080	3.082
Std. Dev. NX/GDP	1.111	1.087	0.950
Imports / Absorption	0.231	0.232	0.232
Avg. Realized SDF	0.988	1.002	1.014
Std. Dev. Realized SDF	0.247	0.261	0.253
corr(Realized SDF, Absorption)	0.088	0.094	0.091

Table 17: Payment Technology – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*(1)*	*(2)*	*Moment*	*Data*	*(1)*	*(2)*
$\rho_{z,z}$	0.676	0.674	corr(A_t, A_{t-1})	0.878	0.981	0.977
ρ_{z,p_y}	-0.610	-0.679	corr$(A_t, p_{y,t-1})$	-0.270	-0.273	-0.315
ρ_{z,p_x}	-0.649	-0.629	corr$(A_t, p_{A,t-1})$	-0.597	-0.571	-0.628
$\rho_{p_y,z}$	0.158	0.038	corr$(p_{y,t}, A_{t-1})$	0.006	0.006	0.006
ρ_{p_y,p_y}	0.9998	0.99996	corr$(p_{y,t}, p_{y,t-1})$	0.911	0.947	0.965
ρ_{p_y,p_x}	-0.001	-0.0002	corr$(p_{y,t}, p_{A,t-1})$	0.213	0.208	0.284
$\rho_{p_x,z}$	-0.043	-0.386	corr$(p_{A,t}, A_{t-1})$	-0.506	-0.507	-0.436
ρ_{p_x,p_y}	0.135	0.781	corr$(p_{A,t}, p_{y,t-1})$	0.619	0.684	0.454
ρ_{p_x,p_x}	0.85672	-0.17082	corr$(p_{A,t}, p_{A,t-1})$	0.902	0.958	0.233
Std. dev. ν_z	0.0023	0.0000	Std. dev. (A_t)	0.023	0.024	0.025
Std. dev. ν_y	0.0030	0.0015	Std. dev. $(p_{y,t})$	0.031	0.014	0.006
Std. dev. ν_x	0.0005	0.0150	Std. dev. $(p_{A,t})$	0.009	0.007	0.015
corr(ν_z, ν_{p_y})	0.000001	0.00003	corr$(A_t, p_{y,t})$	-0.142	-0.145	-0.160
corr(ν_z, ν_{p_x})	-0.9967	-0.9980	corr$(A_t, p_{A,t})$	-0.598	-0.560	-0.553
corr(ν_{p_y}, ν_{p_x})	0.0683	0.0631	corr$(p_{y,t}, p_{A,t})$	0.431	0.470	0.376

Table 18: Payment Technology – Estimated Parameters

4.3 Results

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
(1) $\psi = 0.80$	-0.306	1.016
(2) $\psi = 0.40$	-0.307	0.614

Table 19: Payment Technology – Import Elasticities

5 Sensitivity Analysis

5.1 International Financial Autarky

In this subsection, we investigate the implications of our model under international financial autarky. To do so, we re-estimate the model according to the approach discussed in Section 5 of the paper. Also, given financial autarky, we set $\eta_b = \infty$ and remove the standard deviation of the net exports to GDP ratio from the set of target moments The tables in the following subsections report the results. Tables 20-22 report the parameterizations of these economies. Table 23 reports the price and income elasticities implied by these economies.

A. Predetermined Parameters

Parameter		*Autarky*
Intertemporal elasticity of substitution	$1/\gamma$	0.50
Share of consumption in utility	μ	0.34
Share of capital in production	θ	0.36
Depreciation rate	δ	0.025
Share of imports that arrive today	φ	0.63

Table 20: International Financial Autarky – Predetermined Parameters

B. Estimated Parameters

Parameter		*Autarky*
Elasticity of substitution	σ	1.305
Capital adjustment cost	η_k	2.179
Bond adjustment cost	η_b	∞
Trade cost	τ	50.841
Discount factor	β	0.990
Surplus consumption autocorrelation	ρ_s	0.668
S.S. surplus consumption	$\bar{s}$	0.00012
Moment	*Data*	*Autarky*
Empirical Price Elasticity	-0.301	-0.285
Std. Dev. Investment / Std. Dev. GDP	3.117	3.303
Imports / Absorption	0.231	0.231
Avg. Realized SDF	0.988	1.016
Std. Dev. Realized SDF	0.247	0.264
corr(Realized SDF, Absorption)	0.088	0.094

Table 21: International Financial Autarky – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*Autarky*	*Moment*	*Data*	*Autarky*
$\rho_{z,z}$	0.878	$\text{corr}(A_t, A_{t-1})$	0.878	0.986
ρ_{z,p_y}	-0.270	$\text{corr}(A_t, p_{y,t-1})$	-0.270	-0.218
ρ_{z,p_x}	-0.597	$\text{corr}(A_t, p_{A,t-1})$	-0.597	-0.695
$\rho_{p_y,z}$	0.006	$\text{corr}(p_{y,t}, A_{t-1})$	0.006	0.006
ρ_{p_y,p_y}	0.911	$\text{corr}(p_{y,t}, p_{y,t-1})$	0.911	0.976
ρ_{p_y,p_x}	0.213	$\text{corr}(p_{y,t}, p_{A,t-1})$	0.213	0.251
$\rho_{p_x,z}$	-0.506	$\text{corr}(p_{A,t}, A_{t-1})$	-0.506	-0.577
ρ_{p_x,p_y}	0.619	$\text{corr}(p_{A,t}, p_{y,t-1})$	0.619	0.485
ρ_{p_x,p_x}	0.902	$\text{corr}(p_{A,t}, p_{A,t-1})$	0.902	0.938
Std. dev. ν_z	0.023	Std. dev. (A_t)	0.023	0.016
Std. dev. ν_y	0.031	Std. dev. $(p_{y,t})$	0.031	0.019
Std. dev. ν_x	0.009	Std. dev. $(p_{A,t})$	0.009	0.006
$\text{corr}(\nu_z, \nu_{p_y})$	-0.142	$\text{corr}(A_t, p_{y,t})$	-0.142	-0.112
$\text{corr}(\nu_z, \nu_{p_x})$	-0.598	$\text{corr}(A_t, p_{A,t})$	-0.598	-0.650
$\text{corr}(\nu_{p_y}, \nu_{p_x})$	0.431	$\text{corr}(p_{y,t}, p_{A,t})$	0.431	0.386

Table 22: International Financial Autarky – Estimated Parameters

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
International Financial Autarky	-0.285	1.194

Table 23: International Financial Autarky – Import Elasticities

5.2 Target Real Interest Rate Moments

In this subsection, we investigate the implications of our model when estimated to match salient features of the real interest rate instead of the SDF. To do so, we re-estimate the model according to the approach discussed in Section 5 of the paper. We measure the real interest rate as the quarterly inflation adjusted rate on the 90-day Treasury bill over the period Q2 1967 to Q3 2013. We adjust for inflation using the consumption price index for all urban consumers (all items less food and energy). The tables in the following subsections report the results. Tables 24-26 report the parameterizations of these economies. Table 27 reports the price and income elasticities implied by these economies.

A. Predetermined Parameters

Parameter		*Target Real Interest Rate*
Intertemporal elasticity of substitution	$1/\gamma$	0.50
Share of consumption in utility	μ	0.34
Share of capital in production	θ	0.36
Depreciation rate	δ	0.025
Share of imports that arrive today	φ	0.63

Table 24: Target Real Interest Rate – Predetermined Parameters

B. Estimated Parameters

Parameter		*Target Real Interest Rate*
Elasticity of substitution	σ	1.331
Capital adjustment cost	η_k	1.820
Bond adjustment cost	η_b	3.340
Trade cost	τ	37.850
Discount factor	β	0.997
Surplus consumption autocorrelation	ρ_s	0.516
S.S. surplus consumption	$\bar{s}$	0.00009
Moment	*Data*	*Target Real Interest Rate*
Empirical price elasticity	-0.301	-0.316
Std. Dev. Investment / Std. Dev. GDP	3.117	2.870
Std. Dev. NX/GDP	1.111	1.045
Imports / Absorption	0.231	0.232
Avg. Realized R (%)	0.270	0.276
Std. Dev. Realized R (%)	0.580	0.585
corr(Realized R, Absorption)	0.046	0.046

Table 25: Target Real Interest Rate – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$

Parameter	*Target Real Interest Rate*	*Moment*	*Data*	*Target Real Interest Rate*
$\rho_{z,z}$	0.697	corr(A_t, A_{t-1})	0.878	0.972
ρ_{z,p_y}	-0.316	corr$(A_t, p_{y,t-1})$	-0.270	-0.247
ρ_{z,p_x}	-0.998	corr$(A_t, p_{A,t-1})$	-0.597	-0.666
$\rho_{p_y,z}$	0.219	corr$(p_{y,t}, A_{t-1})$	0.006	0.006
ρ_{p_y,p_y}	0.957	corr$(p_{y,t}, p_{y,t-1})$	0.911	0.970
ρ_{p_y,p_x}	0.053	corr$(p_{y,t}, p_{A,t-1})$	0.213	0.247
$\rho_{p_x,z}$	-0.027	corr$(p_{A,t}, A_{t-1})$	-0.506	-0.504
ρ_{p_x,p_y}	0.021	corr$(p_{A,t}, p_{y,t-1})$	0.619	0.433
ρ_{p_x,p_x}	0.94758	corr$(p_{A,t}, p_{A,t-1})$	0.902	0.917
Std. dev. ν_z	0.0044	Std. dev. (A_t)	0.023	0.033
Std. dev. ν_y	0.0092	Std. dev. $(p_{y,t})$	0.031	0.040
Std. dev. ν_x	0.0041	Std. dev. $(p_{A,t})$	0.009	0.010
corr(ν_z, ν_{p_y})	0.4783	corr$(A_t, p_{y,t})$	-0.142	-0.129
corr(ν_z, ν_{p_x})	0.6109	corr$(A_t, p_{A,t})$	-0.598	-0.602
corr(ν_{p_y}, ν_{p_x})	-0.0151	corr$(p_{y,t}, p_{A,t})$	0.431	0.364

Table 26: Target Real Interest Rate – Estimated Parameters

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
Target Real Interest Rate	-0.316	1.306

Table 27: Target Real Interest Rate – Import Elasticities

5.3 HP-Filtering

In this subsection, we investigate the implications of our model when HP-filtering the simulated data. First, we examine the implied income and price elasticities of the baseline parameterization of the time-to-ship and static models with and without HP-filtering the simulated data; see Table 28 for these results.

Then, we re-estimate the model such that the moments implied after HP-filtering the simulated data are as close as possible to those observed in the data. To do so, we follow the approach discussed in Section 5 of the paper. The tables in the following subsections report the results. Tables 29-31 report the parameterizations of these economies. Table 32 reports the price and income elasticities implied by these economies.

5.3.1 Baseline Parameterization

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Time-to-Ship Model	-0.304	1.249
No Time-to-Ship	-1.300	1.000
Time-to-Ship Model, HP-filtering simulated data	-0.306	1.505
No Time-to-Ship, HP-filtering simulated data	-1.300	1.000

Table 28: HP-Filtering – Import Elasticities

5.3.2 Re-Estimated Model

A. Predetermined Parameters

Parameter		*HP-filter*
Intertemporal elasticity of substitution	$1/\gamma$	0.50
Share of consumption in utility	μ	0.34
Share of capital in production	θ	0.36
Depreciation rate	δ	0.025
Share of imports that arrive today	φ	0.63

Table 29: HP-Filtering – Predetermined Parameters

B. Estimated Parameters

Parameter		*HP-filter*
Elasticity of substitution	σ	1.222
Capital adjustment cost	η_k	1.839
Bond adjustment cost	η_b	1.613
Trade cost	τ	213.131
Discount factor	β	0.977
Surplus consumption autocorrelation	ρ_s	1.000
S.S. surplus consumption	$\bar{s}$	0.01298
Moment	*Data*	*HP-filter*
Empirical Price Elasticity	-0.301	-0.302
Std. Dev. Investment / Std. Dev. GDP	3.117	3.270
Std. Dev. NX/GDP	1.111	1.106
Imports / Absorption	0.231	0.232
Avg. Realized SDF	0.988	1.003
Std. Dev. Realized SDF	0.247	0.249
corr(Realized SDF, Absorption)	0.088	0.085

Table 30: HP-Filtering – Estimated Parameters

C. Estimated Parameters, Stochastic Process for $\{z, p_y, p_x\}$				
Parameter	*HP-filter*	*Moment*	*Data*	*HP-filter*
$\rho_{z,z}$	0.898	$\text{corr}(A_t, A_{t-1})$	0.878	0.964
ρ_{z,p_y}	-0.210	$\text{corr}(A_t, p_{y,t-1})$	-0.270	-0.317
ρ_{z,p_x}	-0.287	$\text{corr}(A_t, p_{A,t-1})$	-0.597	-0.610
$\rho_{p_y,z}$	0.200	$\text{corr}(p_{y,t}, A_{t-1})$	0.006	0.006
ρ_{p_y,p_y}	0.986	$\text{corr}(p_{y,t}, p_{y,t-1})$	0.911	0.980
ρ_{p_y,p_x}	-0.049	$\text{corr}(p_{y,t}, p_{A,t-1})$	0.213	0.274
$\rho_{p_x,z}$	-0.035	$\text{corr}(p_{A,t}, A_{t-1})$	-0.506	-0.472
ρ_{p_x,p_y}	0.027	$\text{corr}(p_{A,t}, p_{y,t-1})$	0.619	0.484
ρ_{p_x,p_x}	0.99989	$\text{corr}(p_{A,t}, p_{A,t-1})$	0.902	0.817
Std. dev. ν_z	0.0000	Std. dev. (A_t)	0.023	0.018
Std. dev. ν_y	0.00001	Std. dev. $(p_{y,t})$	0.031	0.029
Std. dev. ν_x	0.0064	Std. dev. $(p_{A,t})$	0.009	0.008
$\text{corr}(\nu_z, \nu_{p_y})$	0.3247	$\text{corr}(A_t, p_{y,t})$	-0.142	-0.159
$\text{corr}(\nu_z, \nu_{p_x})$	-0.7564	$\text{corr}(A_t, p_{A,t})$	-0.598	-0.572
$\text{corr}(\nu_{p_y}, \nu_{p_x})$	0.3683	$\text{corr}(p_{y,t}, p_{A,t})$	0.431	0.391

Table 31: HP-Filtering – Estimated Parameters

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
HP-filter	-0.302	1.231

Table 32: HP-Filtering – Import Elasticities

6 Two-Country Model

In this section, we investigate the implications of a two-country version of our model. We begin by describing the economic environment. Then, we estimate the parameters of the model to match the SDF moments, the imports-to-absorption share, and the relative volatility of investment and net exports. We parameterize the stochastic productivity process as in Backus et al. (1994) and keep the elasticity of substitution σ at its baseline value (1.30).

The tables in the following subsections report the results. Tables 33 and 34 report the parameterizations of this economy. Table 35 reports the implied dynamics of absorption and prices. Table 36 reports the price and income elasticities. Table 37 reports additional business cycle implications.

6.1 Setup

- Two countries: home, foreign
- Four goods:
  - Produced by home: good x, home final good

- Produce by foreign: good y, foreign final good
- Only goods x and y can be traded internationally

- Agents in the home country:
  - Representative household (unit measure)
  - Representative producer of good x (unit measure)
  - Representative home final good producer (unit measure)
- Agents in the foreign country:
  - Representative household (unit measure)
  - Representative producer of good y (unit measure)
  - Representative foreign final good producer (unit measure)
- Home final good is the numeraire: $p_t = 1$
- International financial markets:
  - One-period risk-free bond denominated in units of good x at interest rate r_t

6.1.1 Home country

Household

$$\max_{\{c_t, n_t, i_t, k_{t+1}, b_{t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \beta^t \frac{\left[(c_t - h_t)^{\mu}(1-n_t)^{1-\mu}\right]^{1-\gamma}}{1-\gamma} \right\}$$

subject to

$$p_t c_t + p_t i_t + \frac{p_{x,t} b_{t+1}}{1+r_t} + p_t \frac{\eta_b}{2} (b_{t+1})^2 + p_t \frac{\eta_k}{2} (k_{t+1} - k_t)^2 = p_t w_t n_t + p_t r_{k,t} k_t + p_{x,t} b_t + \Pi_t$$

$$k_{t+1} = (1-\delta) k_t + i_t$$

$$g_t = \frac{c_t - h_t}{c_t}$$

$$\log g_t = (1-\rho_g) \log \bar{g} + \rho_g \log g_{t-1} + \varphi_t \log \left(\frac{c_t}{c_{t-1}} \right)$$

$$\varphi_t = \frac{1}{\bar{g}} \sqrt{1 - 2(\log g_t - \log \bar{g})} - 1$$

Producer of good x

$$\max_{k_{d,t}, n_{d,t}} p_{x,t} z_t k_{d,t}^{\theta} n_{d,t}^{1-\theta} - p_t w_t n_{d,t} - p_t r_{k,t} k_{d,t}$$

Final good producer

$$
\begin{aligned}
&\max_{\{x_t,y_{t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \left[\beta^t \lambda_t\right] \left[p_t G(x_t, \widetilde{y}_t) - p_{x,t} x_t - \tau p_{y,t} y_{t+1}\right] \right\} \\
&\text{subject to} \\
&G(x_t, \widetilde{y}_t) = \left[x_t^{\rho} + \widetilde{y}_t{}^{\rho}\right]^{\frac{1}{\rho}} \\
&\widetilde{y}_t = (1-\phi) y_t + \phi y_{t+1}
\end{aligned}
$$

where:

- λ_t is the Lagrange multiplier on the period-t budget constraint of the household
- Period-t profits Π_t are given by $p_t G(x_t, \widetilde{y}_t) - p_{x,t} x_t - \tau p_{y,t} y_{t+1}$

6.1.2 Foreign country

Household

$$
\begin{aligned}
&\max_{\left\{c_t^*, n_t^*, i_t^*, k_{t+1}^*, b_{t+1}^*\right\}_{t=0}^{\infty}} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \beta^t \frac{\left[(c_t^* - h_t^*)^{\mu} (1-n_t^*)^{1-\mu}\right]^{1-\gamma}}{1-\gamma} \right\} \\
&\text{subject to} \\
&p_t^* c_t^* + p_t^* i_t^* + \frac{p_{x,t} b_{t+1}^*}{1+r_t^*} + p_t \frac{\eta_b}{2} \left(b_{t+1}^*\right)^2 + p_t \frac{\eta_k}{2} \left(k_{t+1}^* - k_t^*\right)^2 = p_t^* w_t^* n_t^* + p_t^* r_{k,t}^* k_t^* + p_{x,t} b_t^* + \Pi_t^* \\
&k_{t+1}^* = (1-\delta) k_t^* + i_t^* \\
&g_t^* = \frac{c_t^* - h_t^*}{c_t^*} \\
&\log g_t^* = (1-\rho_g) \log \bar{g} + \rho_g \log g_{t-1}^* + \varphi_t^* \log \left(\frac{c_t^*}{c_{t-1}^*} \right) \\
&\varphi_t^* = \frac{1}{\bar{g}} \sqrt{1 - 2(\log g_t^* - \log \bar{g})} - 1
\end{aligned}
$$

Producer of good y

$$
\max_{k_{d,t}^*, n_{d,t}^*} p_{y,t} z_t^* k_{d,t}^*{}^{\theta} n_{d,t}^*{}^{1-\theta} - p_t^* w_t^* n_{d,t}^* - p_t^* r_{k,t}^* k_{d,t}^*
$$

Final good producer

$$\max_{\left\{x^*_{t+1},y^*_t\right\}_{t=0}^{\infty}} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \left[\beta^t \lambda^*_t\right] \left[p^*_t G(\widetilde{x_t}^*, y^*_t) - \tau p_{x,t} x^*_{t+1} - p_{y,t} y^*_t\right] \right\}$$

subject to

$$G(\widetilde{x_t}^*, y^*_t) = \left[\widetilde{x^*_t}^{\rho} + y^{*\rho}_t\right]^{\frac{1}{\rho}}$$

$$\widetilde{x_t}^* = (1-\phi)x^*_t + \phi x^*_{t+1}$$

where:

- λ^*_t is the Lagrange multiplier on the period-t budget constraint of the household
- Period-t profits Π_t are given by $p^*_t G(\widetilde{x_t}^*, y^*_t) - \tau p_{x,t} x^*_{t+1} - p_{y,t} y^*_t$

6.1.3 Stochastic processes

$$z_{t+1} = (1-\rho_z) + \rho_z z_t + \rho_{z,z_*} z^*_t + \varepsilon_{z,t+1}$$
$$z^*_{t+1} = (1-\rho_z) + \rho_z z^*_t + \rho_{z,z_*} z_t + \varepsilon_{z^*,t+1}$$

where $V(\varepsilon_z) = V(\varepsilon_{z^*}) = \sigma^2_z$ and $corr(\varepsilon_z, \varepsilon_{z^*}) = \sigma_{z,z^*}$.

6.1.4 Market clearing conditions

Capital

$$k_{t+1} = k_{d,t+1}$$
$$k^*_{t+1} = k^*_{d,t+1}$$

Labor

$$n_t = n_{d,t}$$
$$n^*_t = n^*_{d,t}$$

Intermediate goods

$$x_t + \tau x^*_{t+1} = z_t k^{\theta}_t n^{1-\theta}_{d,t}$$
$$\tau y_{t+1} + y^*_t = z^*_t k^{*\theta}_t {n^*_{d,t}}^{1-\theta}$$

Final goods

$$G(x_t, \widetilde{y_t}) = c_t + i_t + \Phi^b(b_{t+1}) + \Phi^k(k_{t+1}, k_t)$$
$$G(\widetilde{x_t}^*, y_t^*) = c_t^* + i_t^* + \Phi^b(b_{t+1}^*) + \Phi^k(k_{t+1}^*, k_t^*)$$

Financial markets

$$b_{t+1} + b_{t+1}^* = 0$$
$$r_t = r_t^*$$

6.2 Parameterization

A. Predetermined Parameters

Parameter		*Baseline*	*2 countries*
Intertemporal elasticity of substitution	$1/\gamma$	0.50	0.50
Share of consumption in utility	μ	0.34	0.34
Share of capital in production	θ	0.36	0.36
Depreciation rate	δ	0.025	0.025
Elasticity of substitution	σ	1.300	1.300
Share of imports that arrive today	φ	0.63	0.63
Productivity persistence		–	0.906
Productivity spillover across countries		–	0.088
Std. deviation of productivity		–	0.00852
Correlation between home and foreign shocks		–	0.258

Note: σ is predetermined at its baseline value (1.32).

Table 33: Two Country Model – Predetermined Parameters

B. Estimated Parameters

Parameter		*Baseline*	*2-countries*
Capital adjustment cost	η_k	2.114	0.00002
Bond adjustment cost	η_b	0.860	0.003
Trade cost	τ	52.367	54.605
Discount factor	β	0.972	0.998
Surplus consumption autocorrelation	ρ_s	0.635	0.515
S.S. surplus consumption	$\bar{s}$	0.00035	0.00094
Moment	*Data*	*Baseline*	*2-countries*
Std. Dev. Investment / Std. Dev. GDP	3.117	3.061	3.272
Std. Dev. NX/GDP	1.111	1.099	0.351
Imports / Absorption	0.231	0.231	0.232
Avg. Realized SDF	0.988	0.999	1.037
Std. Dev. Realized SDF	0.247	0.253	0.267
corr(Realized SDF, Absorption)	0.088	0.090	0.110

Table 34: Two Country Model – Estimated Parameters

Moment	*Data*	*Baseline*	*2-countries*
corr(A_t, A_{t-1})	0.878	0.981	0.597
corr$(A_t, p_{y,t-1})$	-0.270	-0.288	0.104
corr$(A_t, p_{A,t-1})$	-0.597	-0.574	-0.208
corr$(p_{y,t}, A_{t-1})$	0.006	0.006	0.508
corr$(p_{y,t}, p_{y,t-1})$	0.911	0.963	0.869
corr$(p_{y,t}, p_{A,t-1})$	0.213	0.208	-0.297
corr$(p_{A,t}, A_{t-1})$	-0.506	-0.507	0.162
corr$(p_{A,t}, p_{y,t-1})$	0.619	0.656	0.293
corr$(p_{A,t}, p_{A,t-1})$	0.902	0.954	-0.275
Std. dev. (A_t)	0.023	0.020	0.012
Std. dev. $(p_{y,t})$	0.031	0.026	0.004
Std. dev. $(p_{A,t})$	0.009	0.008	0.000
corr$(A_t, p_{y,t})$	-0.142	-0.148	0.414
corr$(A_t, p_{A,t})$	-0.598	-0.564	-0.571
corr$(p_{y,t}, p_{A,t})$	0.431	0.451	-0.080

Table 35: Two Country Model – Absorption and Price Dynamics

6.3 Results

	Price Elasticity	*Income Elasticity*
Data	-0.301	1.627
Baseline	-0.304	1.249
Time-to-Ship Model, 2 countries	-1.262	0.938

Table 36: Two Country Model – Import Elasticities

	Data	*Baseline*	*2-countries*
σ(GDP)	1.982	2.800	1.061
σ(C)/σ(GDP)	0.998	0.325	0.016
corr(GDP$_t$,GDP$_{t-1}$)	0.817	0.972	0.684
corr(GDP$_t$,C$_t$)	0.750	0.551	0.347
corr(GDP$_t$,I$_t$)	0.848	0.967	0.943
corr(GDP$_t$,NX$_t$)	-0.090	0.679	-0.359
σ(TOT)	1.875	3.086	0.486
corr(TOT$_t$,TOT$_{t-1}$)	0.803	0.964	0.853
corr(TOT$_t$,NX$_t$)	-0.209	-0.258	-0.321
corr(TOT$_t$,GDP$_t$)	-0.023	0.174	0.500

Table 37: Two Country Model – Other Business Cycle Moments

7 Evidence on Time-to-Ship and Bilateral Import Volatility

In this section we report additional findings on the relationship between time-to-ship and bilateral import volatility. In particular, here we extend the findings reported in Section 8 of the paper to control for variables that are commonly used to account for bilateral trade flows. These results are reported in Table 38.

Dependent variable: Imports Volatility

	Without controls	With controls
Time-to-ship (log	0.080***	0.102***
Distance (log)	—	-0.023*
Common language	—	0.011
GDP per capita (log)	—	0.004
R-squared	0.18	0.20
Observations	82	82

Note: Imports volatility measured as the standard deviation of the deviations of imports (log) around an HP-1600 trend. Three asterisks denote statistical significance at 1% level, while one asterisk denotes significance at 10% level.

Table 38: Regression of Imports Volatility on Time-to-Ship

References

Backus, D. K., Kehoe, P. J. & Kydland, F. E. (1994), 'Dynamics of the Trade Balance and the Terms of Trade: The J-Curve?', *American Economic Review* **84**(1), 84–103.