Table 1: US Business Cycle Statistics on Imports

US Imports and Sales of Japanese Motor Vehicles (2007m1 to 2011m12)

	Volatility rel. to Sales	Autocorrel.	Correlation with Sales	Correlation with Imports
Sales (all cars)*	16.4	0.81	1	
Imports (Census)	2.06	0.78	0.71	1
US Sales Japan cars'	1.38	0.85	0.90	0.72
Import Price	0.09	0.94	-0.54	-0.47
Naïve Import Wedge	1.47	0.49	0.22	0.83
Actual Import Wedge	0.60	0.79	0.15	0.25

US Aggregate Imports (1995Q1 to 2010q4)

	Volatility rel. to IP	Autocorrel.	Correlation with IPMFR	Correlation with Imports
Industrial Production (IP)*	3.44	0.91	1.00	
Imports Goods	1.40	0.86	0.92	1.00
Import Price	0.36	0.83	0.08	0.21
Naïve Import Wedge	1.08	0.78	0.86	0.94
Import Ratio	0.84	0.73	0.78	0.93
Actual Import Wedge	0.80	0.67	0.81	0.85

* Sales and IP volatility are absolute, not relative. Import Price measured relative to price of final basket.

Table 2: Change in Japan Passenger Car Production, Sales, and Exports

Change from	Nov. 08 to Aug. 09 vs May 08 to Oct. 08	Sep. 09 to Aug 10 vs Nov. 08 to Aug. 09
Export share of production in previous period	0.59	0.48
Production	-0.42	0.25
Domestic Sales	-0.12	0.21
Exports	-0.63	0.27
Exports plus Domestic sales	-0.39	0.23
Global Sales*	-0.20	0.05
US Sales	-0.26	-0.11
US Exports	-0.65	0.28

* Global Sales measures the change in Domestic Sales + Foreign Sales where US Sales is a proxy for sales outside of Japan

Table 3: Parameter Values

		Benchmark	No Habit	No Inventory
	Assigned Parameters			
β	discount factor	0.99	0.99	0.99
γ	Armington elasticity of H vs. F	1.5	1.5	1.5
θ	elasticity across varieties in H & F	3	3	3
$\delta 0_s$	inventory depreciation	0.016	0.016	
$\delta 1_s$	Elasticity of inventory depreciation	-0.0044	-0.0045	
μ	Elasticity of inventory costs	0	0	
η	Frisch Elasticity	0.5	0.5	0.5
h	Habit	0.30	0	0.3
δ	Capital Depreciation	0.025	0.025	0.025
α	Capital Share	0.33	0.33	0.33
	Calibrated Parameters			
ad	home taste shocks	1.3	1.3	1.3
af	foreign taste shocks	1.0001	1.0001	1.3
τ	foreign weight	0.335	0.335	0.36

Table 4: Business cycle statistics model and data

		Inventory Model - Endogenous Costs							No Inventory			
Standard Deviations:	*Data*	*Benchmark*	*Balanced RNX*	*Trade shocks*	*No Import Premium*	*Low Depreciation*	*Asymmetry - High*	*Asymmetry - Low*	*Benchmark*	*Balanced RNX*	*Trade shocks*	*Comove fixed*
Production	3.44	3.33	3.27	3.53	3.34	3.33	3.33	3.35	3.4	3.45	5.12	3.39
NX, NX/(EX+M)	2.67	3.08	0	2.98	2.79	2.51	3.01	3.01	1.96	0	6.45	2.44
NX/sales	0.28	0.33	0	0.32	0.29	0.26	0.32	0.29	0.21	0	0.68	0.26
NII/sales	0.45	0.82	0.62	0.88	0.80	0.77	0.86	0.72				
Standard Deviations (rel. to IP):												
Consumption, C	0.46	0.53	0.56	0.61	0.53	0.54	0.55	0.52	0.63	0.69	1.34	0.62
Employment, L	0.82	0.62	0.61	0.68	0.62	0.62	0.62	0.62	0.62	0.62	0.96	0.61
Total investment, X + Delta S	2.89	2.89	2.3	2.89	2.89	2.88	2.89	2.89	2.9	2.69	2.88	2.89
Investment, X	1.62	1.62	1.31	1.62	1.62	1.62	1.62	1.62	2.9	2.69	2.87	2.89
Inventory Stock	0.63	0.54	0.44	0.55	0.51	0.49	0.56	0.47				
Exports	1.49	1.07	0.99	1.3	0.92	1.04	0.95	1.08	0.89	0.84	1.63	0.9
Imports	1.4	1.07	0.99	1.3	0.92	1.04	1.09	0.94	0.89	0.84	1.63	0.9
RER	0.89	0.2	0.24	0.32	0.18	0.19	0.19	0.19	0.27	0.23	1.18	0.29
TOT	0.27	0.4	0.54	0.45	0.37	0.40	0.38	0.38	0.57	0.49	1.03	0.61
Inventory Sales Ratio	0.82	0.52	0.52	0.53	0.53	0.53	0.48	0.56				
Sales (incl Mfr)	0.72	0.78	0.76	0.81	0.78	0.78	0.78	0.77	0.97	1	1.29	0.97
Wedge	1.08	0.79	0.66	1.09	0.61	0.74	0.85	0.58			1.07	
AutoCorrelations:												
Production, IP	0.91	0.7	0.69	0.69	0.70	0.69	0.69	0.70	0.72	0.72	0.7	0.73
NX, NX/(EX+M)	0.78	0.71		0.56	0.70	0.71	0.61	0.61	0.4		0.47	0.32
NX, NX/sales	0.76	0.71		0.56	0.70	0.71	0.61	0.61	0.4		0.47	0.32
NII/salesM	0.61	0.55	0.52	0.58	0.53	0.54	0.49	0.60				
Consumption, C	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.63	0.72	0.64	0.74
Employment, L	0.91	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.73	0.72	0.71	0.74
Total investment, X + Delta S	0.79	0.64	0.63	0.65	0.64	0.63	0.58	0.71	0.86	0.73	0.92	0.81
Investment, X	0.9	0.95	0.95	0.95	0.95	0.95	0.95	0.95				
Inventory Stock	0.92	0.92	0.93	0.93	0.92	0.92	0.91	0.93				
Exports	0.85	0.67	0.66	0.51	0.69	0.66	0.76	0.55	0.68	0.72	0.67	0.66
Imports	0.86	0.67	0.66	0.51	0.69	0.66	0.55	0.76	0.68	0.72	0.67	0.66
RER	0.76	0.78	0.75	0.75	0.78	0.76	0.77	0.77	0.65	0.72	0.67	0.61
TOT	0.71	0.74	0.74	0.74	0.75	0.74	0.74	0.74	0.65	0.72	0.62	0.61
Inventory Sales Ratio	0.78	0.73	0.71	0.71	0.73	0.72	0.70	0.76				
Sales (incl Mfr)	0.91	0.79	0.78	0.79	0.79	0.79	0.79	0.80	0.74	0.72	0.72	0.75
Wedge	0.78	0.57	0.56	0.43	0.55	0.56	0.48	0.59			0.72	

Balanced RNX denotes a case where real exports = real imports. Trade shocks denotes a shock to trade weight that matches the volatility of the trade wedge in the inventory and no inventory models. Asymmetry High and Low denote countries with high and low retail inventory levels. Comove fixed means choosing the international correlation of productivity shocks to achieve the same cross-correlation of output as in our benchmark inventory model.

Table 5: Business cycle statistics model and data: Cross Correlations

		Inventory Model - Endogenous Costs							No Inventory			
Correlation with IP:	*Data*	*Benchmark*	*Balanced RNX*	*Trade shocks*	*No Import Premium*	*Low Depreciation*	*Asymmetry - High*	*Asymmetry - Low*	*Benchmark*	*Balanced RNX*	*Trade shocks*	*Comove fixed*
NX, NX/(EX+M)	-0.04	-0.25		-0.23	-0.31	-0.18	-0.32	-0.19	0.33		0.25	0.29
NX/sales	-0.42	-0.25		-0.23	-0.31	-0.18	-0.32	-0.19	0.33		0.25	0.29
NII/sales	0.56	0.71	0.82	0.73	0.73	0.71	0.69	0.74				
Consumption, C	0.8	0.96	0.96	0.96	0.96	0.96	0.96	0.95	0.97	1	0.97	0.97
Employment, L	0.91	1	0.99	1	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99
Total investment, X + NII	0.86	0.94	0.99	0.95	0.95	0.95	0.94	0.95	0.95	0.99	0.81	0.95
Investment, X	0.92	0.67	0.6	0.62	0.70	0.66	0.66	0.70	0.95	0.99	0.82	0.95
Inventory Stock	0.81	0.71	0.64	0.69	0.70	0.74	0.77	0.64		-0.31		
Exports	0.85	0.63	0.83	0.68	0.59	0.70	0.67	0.57	0.9	0.84	0.91	0.87
Imports	0.92	0.85	0.83	0.83	0.87	0.83	0.85	0.83	0.69	0.84	0.72	0.64
RER	-0.38	0.55	0.54	0.56	0.54	0.56	0.61	0.49	0.53	0.55	0.45	0.55
TOT	0.69	0.56	0.55	0.55	0.56	0.56	0.60	0.52	0.53	0.55	0.44	0.55
Inventory-Sales Ratio (IS)	-0.03	-0.96	-0.98	-0.96	-0.95	-0.97	-0.95	-0.96		-0.33		
Sales (incl Mfr)	0.97	0.97	0.97	0.97	0.98	0.97	0.97	0.97	1	1	0.99	0.99
Wedge	0.86	0.68	0.83	0.74	0.65	0.67	0.65	0.66		-0.01	0.97	
Correlations:												
IP and IPs*	0.6	0.35	0.4	0.37	0.34	0.35	0.35	0.35	0.42	0.4	0.57	0.35
L and Ls*	0.39	0.49	0.61	0.51	0.47	0.50	0.35	0.35	0.65	0.61	0.72	0.6
C and Cs*	0.38	0.56	0.47	0.53	0.55	0.58	0.48	0.48	0.75	0.39	0.71	0.67
X and Xs*	0.33	0.09	0.73	0.16	0.20	0.26	0.23	0.23	0.22	0.42	0.25	0.17
IS and Sales	-0.13	-0.91	-0.93	-0.9	-0.90	-0.92	-0.89	-0.92				
Total Investment and NII	0.87	0.56	0.58	0.54	0.60	0.56	0.52	0.65				
Exports and Imports	0.85	0.63	1	0.79	0.59	0.74	0.61	0.61	0.79	1	0.7	0.68
TOT and RER	-0.16	1	1	1	1.00	1.00	1.00	1.00	1	1	0.99	1
NIIY AND X	0.47	0.04	0.05	0.02	0.10	0.01	-0.01	0.15				
Wedge and TOT	0.09	0.24	0.41	0.27	0.29	0.20	0.29	0.25			0.6	
Wedge and Imports	0.88	0.86	0.78	0.91	0.79	0.84	0.87	0.77			0.57	

*Taken from Chari, Kehoe, and McGrattan (2002) based on the US and Europe

Appendix to Trade Wedges, Inventories, and the International Business Cycles

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1. Summary

The appendix describes the data used in the paper, the equations of the model, some additional sensitivity, and presents impulse response functions for the models with wedge shocks.

A. Data Appendix
Source: US Data

1. Output: Industrial Production: Manufacturing [SIC] (SA, 2007=100)
2. Investment = NII + I_E
   (a) NII = Real Change in Private Inventories (SAAR, Bil.Chn.2005$)
   (b) I^{eqs} =Real Private Nonresidential Investment: Equipment & Software (SAAR, Bil.Chn.2005$)
3. Real Exports of Goods (SAAR, Bil.Chn.2005$)
4. Real Imports of Goods (SAAR, Bil.Chn.2005$)
5. Aggregate Hours: Nonfarm Payrolls, Manufacturing (SAAR, Bil.Hrs)
6. PCEG = Real Personal Consumption Expenditures: Goods (SAAR, Bil.Chn.2005.$)
7. Real Expenditures on Tradeable Goods = Investment + PCEG
8. Real Manufacturing & Trade Inventories: All Industries (EOP, SA, Mil.Chn.2005$)
9. Real Manufacturing & Trade Sales: All Industries (SA, Mil.Chn.2005$)
10. Real Broad Trade-Weighted Exchange Value of the US$ (Mar-73=100)

11. Terms of Trade: Price of Exports of nonagricultural goods/Price of Imports of nonpetroleum goods from the BEA
12. Price of Goods = $\text{PCE}^{0.75}\text{P}_I^{0.25}$
    (a) Personal Consumption Expenditures: Goods: Price Index (SA, 2005=100)
    (b) Private Nonresidential Fixed Investment: Chain Price Index (SA, 2005=100)

Source Data: Motor Vehicles.

1. Japan
    (a) Exports of Passenger Cars. JAMA: Active Matrix Database System. Seasonally adjusted using X-12.
    (b) Production of Passenger Cars. JAMA: Active Matrix Database System. Seasonally adjusted using X-12.
    (c) New Car Registrations Sales. JAMA: Active Matrix Database System. Seasonally adjusted using X-12.
    (d) Real and Nominal Exports and Imports:
        i. http://www.esri.cao.go.jp/en/sna/sokuhou/qe/gdemenu_ea.html
    (e) Nominal Motor Vehicle Imports and Exports (Ministry of Finance/Japan Tariff Association)
2. US
    (a) Production: IP: Motor Vehicles (SA, 2007=100) from Federal Reserve (IPG61@IP)
    (b) Sales: US: Light Vehicle Sales (NSA, Units) - Seasonal Adjustment, All from WARDS (sa(UV@WARDS))
    (c) Japanese Exports of Passenger Cars to the U.S. (NSA, Number), JAMA: Active Matrix Database System. Seasonally adjusted using X-12.
    (d) U.S. Light Vehicle Sales Imported from Japan (NSA, Units), Wards Automotive Group/Haver Analytics (UVJP@WARDS). Seasonally adjusted using X-12.
    (e) U.S.: Light Vehicle Inventory Imported from Japan (NSA, Units), Wards Automotive Group/Haver Analytics (UZJP@WARDS). Seasonally adjusted using X-12.
    (f) US CPI New Vehicles: CPI-U: New Cars (SA, 1982-84=100) (UTWC@CPIDATA))
    (g) US Import Price Deflators of Japanese cars proxied for by Japan: All Goods: US Import Price Index (NSA, 2000=100) (sa(PMOJAP@USINT))
3. EU
    (a) EU 27: IP: Motor Vehicles (SA, 2005=100) Eurostat (S997Q291@EUDATA)
    (b) EU 27: New Car Registrations (SA, 2006=100) Eurostat (S997CVRI@EUDATA)

2. Sensitivity

We describe the effect of having habit in preferences, restricting asset trade to a non-contingent bond, and the elasticity of substitution on the quantitative properties of the model. The results are in Tables 6 and 7.

A. Role of Habit

Focusing on Table 6, introducing habit persistence allows consumption to be as persistent as in the data. The persistence of consumption leads to more persistent movements in international trade in the model with inventories. With habit the volatility of imports falls from 1.13 to 1.07 in our benchmark inventory formulation and the autocorrelation rises from 0.55 to 0.67. The less volatile imports lead to less volatile and less countercyclical real net exports. Without inventories, adding habit has little effect, except to lower both the cyclicality (Table 5) and persistence (Table 6) of net exports slightly. Overall the impact of habit is relatively minor.

B. Incomplete Markets

In the next three columns we consider a model with incomplete asset markets. Specifically, we assume that the only asset traded across countries is a non-contingent bond that is in zero net supply. To keep the economy stationary, we introduce a small quadratic adjustment cost on the bond position relative to the steady-state bond position, $\overline{B}$, which is set to zero. The home country budget constraint then becomes

$$\sum_{i=\{H,F\}} \int_0^1 p_i(j)\, y_i(j) dj + Q_{t+1} B_{t+1} + \phi_D \left(\frac{B_{t+1}}{\overline{B}} - 1 \right) = Wl + Rk + \Pi + B_t.$$

For simplicity we assume that the retailers are owned by the agents in the country whose good they sell. With this convention, profits here are equal to retailers' profits plus intermediate producer profits.

$$\Pi = \int_0^1 p_H(j)\, y_H(j) dj + \int_0^1 p_H^*(j)\, y_H^*(j) dj - Wl + Rk$$

From the column titled *Bond* we see that introducing the non-contingent bond has a very small impact on our quantitative results. This is not surprising as it is well known that incomplete asset markets tend to have a small impact when shocks are not permanent so that wealth effects are fairly minor.

To allow for more substantial wealth effects, we next examine the properties of the bond economy when shocks are close to permanent ($\rho = 0.995$) . The final two columns report the statistics of the Benchmark economy with permanent shocks and the Bond economy with permanent shocks. Once again the role of market incompleteness is fairly moderate. The largest impact is on the cyclicality of net exports, which is about 10 percentage points more countercyclical with incomplete markets. This difference arises because in the bond economy consumption is substantially less correlated than in the complete markets economy (0.56 vs. 0.70).

C. Elasticity of Substitution

We next consider how the elasticity of substitution affects our results. There is a wide range of estimates for this parameter. Lowering the elasticity to 0.5 leads to less substitution following a shock and this increases the volatility of trade from 1.07 to 1.14 and the wedge from 0.79 to 0.81. Net exports become less countercyclical as comovement increases substantially (the correlation of output rises from 0.35 to 0.47). Increasing the elasticity of substitution to 2.5 actually lowers the volatility of trade flows slightly to 1.04 and makes the wedge slightly less volatile. Real net exports are slightly more countercyclical as business cycles become less correlated (the correlation of output drops to 0.31).

3. Full set of equilibrium conditions

Home Consumer Optimality:

$$\begin{aligned}
\frac{w_t}{P_t} &= -\frac{U_{l,t}}{U_{c,t}} \\
1 &= \beta E_t \frac{U_{c,t+1}}{U_{c,t}} \frac{\left[\frac{r_{t+1}}{P_{t+1}} + \left((1-\delta) + \xi\left(\frac{x_{t+1}}{k_t} - \delta\right) + \frac{\xi}{2}\left(\frac{x_{t+1}}{k_t} - \delta\right)^2\right)\right]}{1 + \xi\left(\frac{x_t}{k_{t-1}} - \delta\right)} \\
x_t &= \left[k_t - (1-\delta)\, k_{t-1}\right]
\end{aligned}$$

Foreign Consumer Optimality

$$\begin{aligned}
\frac{w_t^*}{P_t^*} &= -\frac{U_{l,t}^*}{U_{c,t}^*} \\
1 &= \beta E_t \frac{U_{c,t+1}^*}{U_{c,t}^*} \frac{\left[\frac{r_{t+1}^*}{P_{t+1}^*} + \left((1-\delta) + \xi\left(\frac{x_{t+1}^*}{k_t^*} - \delta\right) + \frac{\xi}{2}\left(\frac{x_{t+1}^*}{k_t^*} - \delta\right)^2\right)\right]}{1 + \xi\left(\frac{x_t^*}{k_{t-1}^*} - \delta\right)} \\
x_t^* &= \left[k_t^* - (1-\delta)\, k_{t-1}^*\right]
\end{aligned}$$

Home Producer's Optimality:

$$\begin{aligned}
M_t &= A_t k_t^{\alpha} l_t^{1-\alpha} \\
\alpha\omega_t \frac{m_t}{k_{t-1}} &= r_t \\
(1-\alpha)\,\omega_t \frac{m_t}{l_t} &= w_t \\
\omega_t &= \frac{r_t^{\alpha} w_t^{1-\alpha}}{A_t}
\end{aligned}$$

Foreign Producer's Optimality:

$$\begin{aligned} M_t^* &= A_t^* k_t^{*\alpha} l_t^{*1-\alpha} \\ \alpha\omega_t^* \frac{m_t^*}{k_{t-1}^*} &= r_t^* \\ (1-\alpha)\,\omega_t^* \frac{m_t^*}{l_t^*} &= w_t^* \\ \omega_t^* &= \frac{r_t^{*\alpha} w_t^{*1-\alpha}}{A_t^*} \end{aligned}$$

Home Pricing:

$$\begin{aligned} \hat{p}_{H,t} &= \frac{\theta}{\theta-1} E\left[(1-\delta_{s,t})\,\frac{Q_{t+1}}{Q_t}\omega_{t+1}\right] \\ \hat{p}_{F,t} &= \frac{\theta}{\theta-1} E\,(1-\delta_{s,t})\,\frac{Q_{t+1}^*}{Q_t^*}\omega_{t+1}^* \\ P_{H,t} &= \hat{p}_{H,t}\left[\hat{v}_{H,t}^{1-a_{DOM}}\left(\frac{a_{DOM}}{1-a_{DOM}} - \frac{a_{DOM}}{\frac{1}{\theta}-a_{DOM}}\right) - \frac{a_{DOM}}{1-a_{DOM}}\right]^{\frac{1}{1-\theta}} \\ P_{F,t} &= \hat{p}_{F,t}\left[\hat{v}_{F,t}^{1-a_{IMP}}\left(\frac{a_{IMP}}{1-a_{IMP}} - \frac{a_{IMP}}{\frac{1}{\theta}-a_{IMP}}\right) - \frac{a_{IMP}}{1-a_{IMP}}\right]^{\frac{1}{1-\theta}} \\ P_t &= \left[P_{H,t}^{1-\gamma} + \tau P_{F,t}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} \end{aligned}$$

$$(1) \quad \hat{v}_{H,t} = \left(\frac{\frac{1}{\theta}}{a_{DOM}-\frac{1}{\theta}}\right)^{1/a_{DOM}} \left(\frac{\omega_t}{E_t\,(1-\delta_{s,t})\,\frac{Q_{t+1}}{Q_t}\omega_{t+1}} - 1\right)^{-1/a_{DOM}}$$

$$(2) \quad \hat{v}_{F,t} = \left(\frac{\frac{1}{\theta}}{a_{IMP}-\frac{1}{\theta}}\right)^{1/a_{IMP}} \left(\frac{\omega_t^*}{E_t\,(1-\delta_{s,t})\,\frac{Q_{t+1}^*}{Q_t^*}\omega_{t+1}^*} - 1\right)^{-1/a_{IMP}}$$

Foreign Pricing:

$$\begin{aligned} \hat{p}_{H,t}^* &= \frac{\theta}{\theta-1}\left(1-\delta_{s,t}^*\right) E_t \frac{Q_{t+1}}{Q_t}\omega_{t+1} \\ \hat{p}_{F,t}^* &= \frac{\theta}{\theta-1}\left(1-\delta_{s,t}^*\right) E_t \frac{Q_{t+1}^*}{Q_t^*}\omega_{t+1}^* \\ P_{H,t}^* &= \hat{p}_{H,t}^*\left[\hat{v}_{H,t}^{*1-a_{IMP}}\left(\frac{a_{IMP}}{1-a_{IMP}} - \frac{a_{IMP}}{\frac{1}{\theta}-a_{IMP}}\right) - \frac{a_{IMP}}{1-a_{IMP}}\right]^{\frac{1}{1-\theta}} \\ P_{F,t}^* &= \hat{p}_{F,t}^*\left[\hat{v}_{F,t}^{*1-a_{DOM}}\left(\frac{a_{DOM}}{1-a_{DOM}} - \frac{a_{DOM}}{\frac{1}{\theta}-a_{DOM}}\right) - \frac{a_{DOM}}{1-a_{DOM}}\right]^{\frac{1}{1-\theta}} \\ P_t^* &= \left[\tau P_{H,t}^{*1-\gamma} + P_{F,t}^{*1-\gamma}\right]^{\frac{1}{1-\gamma}} \end{aligned}$$

$$(3) \quad \hat{v}^*_{H,t} = \left(\frac{\frac{1}{\theta}}{a_{DOM} - \frac{1}{\theta}}\right)^{1/a_{DOM}} \left(\frac{\omega_t}{E_t\left(1-\delta_{s,t}\right)\frac{Q_{t+1}}{Q_t}\omega_{t+1}} - 1\right)^{-1/a_{DOM}}$$

$$(4) \quad \hat{v}^*_{F,t} = \left(\frac{\frac{1}{\theta}}{a_{IMP} - \frac{1}{\theta}}\right)^{1/a_{IMP}} \left(\frac{\omega^*_t}{E_t\left(1-\delta_{s,t}\right)\frac{Q^*_{t+1}}{Q^*_t}\omega^*_{t+1}} - 1\right)^{-1/a_{IMP}}$$

Home Inventory Stocks:

$$z_{H,t} = \hat{v}_{H,t}\left(\frac{\hat{p}_{H,t}}{P_{H,t}}\right)^{-\theta}\left[\left(\frac{P_{H,t}}{P_t}\right)^{-\gamma} D_t\right]$$

$$z_{F,t} = \hat{v}_{F,t}\left(\frac{\hat{p}_{F,t}}{P_{F,t}}\right)^{-\theta}\left[\tau\left(\frac{P_{F,t}}{P_t}\right)^{-\gamma} D_t\right]$$

$$(5) \quad S_{H,t} = (1-\delta_{s,t})\left[z_{H,t} - \frac{z_{H,t}}{\hat{v}_{H,t}}\left[\frac{1}{1-a_{DOM}}\hat{v}^{1-a_{DOM}}_{H,t} - \frac{a_{DOM}}{1-a_{DOM}}\right]\right]$$

$$(6) \quad S_{F,t} = (1-\delta_{s,t})\left[z_{F,t} - \frac{z_{F,t}}{\hat{v}_{F,t}}\left[\frac{1}{1-a_{IMP}}\hat{v}^{1-a_{IMP}}_{F,t} - \frac{a_{IMP}}{1-a_{IMP}}\right]\right]$$

$$(7) \quad S_t = S_{H,t} + S_{F,t}$$

$$(8) \quad \delta_{s,t} = \delta_{s,0} + \delta_{s,1} e^{\left(S_t/\bar{S}-1\right)}$$

Foreign Inventory Stocks:

$$z^*_{H,t} = \hat{v}^*_{H,t}\left(\frac{\hat{p}^*_{H,t}}{P^*_{H,t}}\right)^{-\theta}\left[\tau\left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\gamma} D^*_t\right]$$

$$z^*_{F,t} = \hat{v}^*_{F,t}\left(\frac{\hat{p}^*_{F,t}}{P^*_{F,t}}\right)^{-\theta}\left[\left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\gamma} D^*_t\right]$$

$$(9) \quad S^*_{H,t} = \left(1-\delta^*_{s,t}\right)\left[z^*_{H,t} - \frac{z^*_{H,t}}{\hat{v}^*_{H,t}}\left[\frac{1}{1-a_{IMP}}\hat{v}^{*1-a_{IMP}}_{H,t} - \frac{a_{IMP}}{1-a_{IMP}}\right]\right]$$

$$(10) \quad S^*_{F,t} = \left(1-\delta^*_{s,t}\right)\left[z^*_{F,t} - \frac{z^*_{F,t}}{\hat{v}^*_{F,t}}\left[\frac{1}{1-a_{DOM}}\hat{v}^{*1-a_{DOM}}_{F,t} - \frac{a_{DOM}}{1-a_{DOM}}\right]\right]$$

$$(11) \quad S^*_t = S^*_{H,t} + S^*_{F,t}$$

$$(12) \quad \delta^*_{s,t} = \delta_{s,0} + \delta_{s,1} e^{\left(S^*_t/\bar{S}-1\right)}$$

Good Market Clearing:

$$M_t = z_{H,t} + z^*_{H,t} - S_{H,t-1} - S^*_{H,t-1}$$

$$M^*_t = z_{F,t} + z^*_{F,t} - S_{F,t-1} - S^*_{F,t-1}$$

Asset Market Clearing:

$$\begin{aligned} Q_t &= \frac{u_{c,t}}{p_t} \\ Q_t^* &= \frac{u_{c,t}^*}{P_t^*} \\ Q_t &= Q_t^* \end{aligned}$$

The numbered equations represent the additional equations from a standard model of BKK with monopolistic retailers. The variables $(\hat{v}_{H,t}, \hat{v}_{F,t}, \hat{v}_{H,t}^*, \hat{v}_{F,t}^*,)$ described in equations (1 to 4) are useful to describe both the distribution of prices and the inventory sales ratio. The next two groups of 4 equations (equations 5 to 12) summarize the law of motion for retail stocks of domestic and imported goods in each country (equations 5, 6, 9, and 10) and the influence of inventories on the holding costs of inventories (equations 7, 8, 11, and 12).

4. Impulse Responses to Productivity in Model with Wedge Shocks

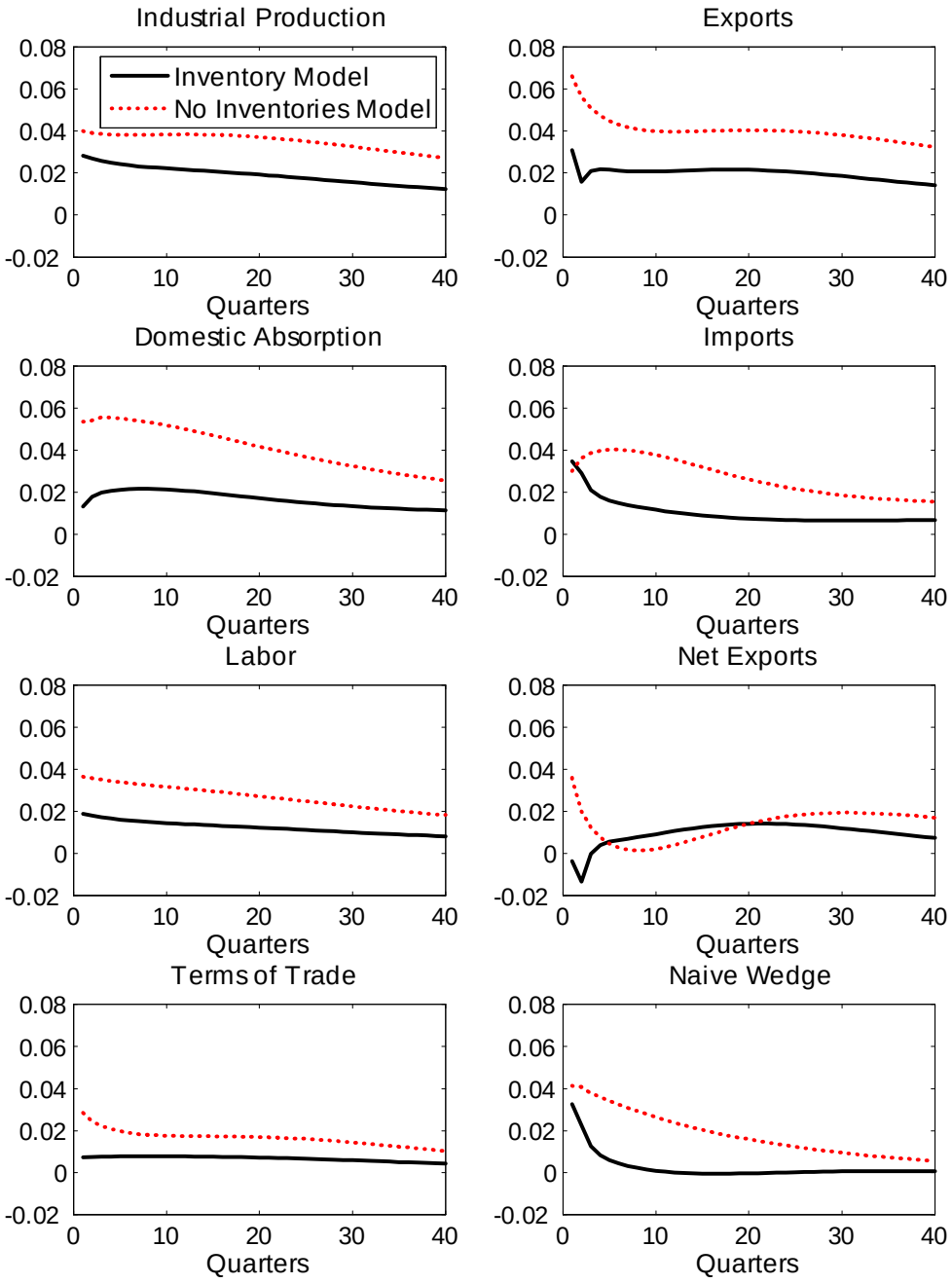
Industrial Production
Inventory Model
No Inventories Model
Exports
Domestic Absorption
Imports
Labor
Net Exports
Terms of Trade
Naive Wedge
0.08
0.06
0.04
0.02
0
-0.02
0
10
20
30
40
Quarters

Table 6: Business cycle statistics model and data

Standard Deviations:	*Data*	*Benchmark*	*No Habit*	*Low elasticity (γ = 0.5)*	*High elasticity (γ = 2.5)*	*Bond Model*	*Benchmark: Permanent*	*Bond Permanent*
Production	3.44	3.33	3.32	3.19	3.38	3.33	3.23	3.25
NX, NX/(EX+M)	2.67	3.08	3.91	3.35	2.99	3.25	4.23	4.35
NX/sales	0.28	0.33	0.41	0.35	0.32	0.34	0.45	0.46
NII/sales	0.45	0.82	0.8	0.75	0.84	0.82	0.80	0.83
Standard Deviations (rel. to IP):								
Consumption, C	0.46	0.53	0.51	0.53	0.54	0.54	0.62	0.65
Employment, L	0.82	0.62	0.62	0.59	0.63	0.62	0.60	0.60
Total investment, X + Delta S	2.89	2.89	2.87	2.89	2.88	2.89	2.89	2.89
Investment, X	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Inventory Stock	0.63	0.54	0.49	0.47	0.55	0.53	0.56	0.55
Exports,	1.49	1.07	1.13	1.14	1.04	1.08	1.13	1.13
Imports,	1.40	1.07	1.13	1.14	1.04	1.08	1.13	1.13
RER	0.89	0.20	0.2	0.42	0.13	0.20	0.27	0.26
TOT	0.27	0.40	0.42	0.87	0.26	0.40	0.55	0.53
Inventory Sales Ratio	0.82	0.52	0.56	0.59	0.50	0.53	0.62	0.64
Sales (incl Mfr)	0.72	0.78	0.76	0.78	0.77	0.78	0.82	0.84
Wedge	1.08	0.79	0.82	0.81	0.77	0.80	0.94	0.96
AutoCorrelations:								
Production, IP	0.91	0.70	0.70	0.70	0.69	0.70	0.70	0.70
NX, NX/(EX+M)	0.78	0.71	0.13	0.72	0.67	0.68	0.34	0.67
NX, NX/sales	0.76	0.71	0.13	0.72	0.67	0.68	0.34	0.67
NII/salesM	0.61	0.55	0.33	0.51	0.54	0.53	0.62	0.60
Consumption, C	0.82	0.82	0.71	0.82	0.82	0.82	0.82	0.82
Employment, L	0.91	0.69	0.70	0.69	0.69	0.69	0.70	0.70
Total investment, X + Delta S	0.79	0.64	0.51	0.63	0.62	0.62	0.69	0.65
Investment, X	0.90	0.95	0.95	0.94	0.95	0.95	0.95	0.95
Inventory Stock	0.92	0.92	0.91	0.91	0.92	0.92	0.94	0.93
Exports,	0.85	0.67	0.55	0.66	0.67	0.66	0.56	0.66
Imports,	0.86	0.67	0.55	0.66	0.67	0.66	0.56	0.66
RER	0.76	0.78	0.77	0.75	0.79	0.78	0.77	0.76
TOT	0.71	0.74	0.74	0.74	0.75	0.75	0.72	0.73
Inventory-Sales Ratio	0.78	0.73	0.67	0.78	0.71	0.73	0.77	0.77
Sales (incl Mfr)	0.91	0.79	0.76	0.80	0.79	0.79	0.80	0.80
Wedge	0.78	0.57	0.31	0.55	0.56	0.55	0.57	0.62

Table 7: Business cycle statistics model and data: Cross Correlations

Correlation with IP:	*Data*	*Benchmark*	*No Habit*	*Low elasticity (γ = 0.5)*	*High elasticity (γ = 2.5)*	*Bond Model*	*Benchmark: Permanent*	*Bond Permanent*
NX/sales	-0.42	-0.25	-0.11	-0.14	-0.28	-0.25	-0.22	-0.32
NII/sales	0.56	0.71	0.68	0.66	0.72	0.69	0.61	0.59
Consumption, C	0.80	0.96	0.98	0.96	0.96	0.96	0.96	0.97
Employment, L	0.91	1.00	1	0.98	1.00	1.00	0.99	0.99
Total investment, X + Delta S	0.86	0.94	0.91	0.92	0.94	0.93	0.86	0.87
Investment, X	0.92	0.67	0.66	0.76	0.63	0.69	0.66	0.68
Inventory Stock	0.81	0.71	0.68	0.71	0.71	0.73	0.59	0.67
Exports,	0.85	0.63	0.64	0.69	0.61	0.61	0.55	0.48
Imports,	0.92	0.85	0.75	0.82	0.85	0.84	0.81	0.86
RER	-0.38	0.55	0.55	0.50	0.56	0.56	0.54	0.55
TOT	0.69	0.56	0.56	0.50	0.57	0.56	0.55	0.55
Inventory-Sales Ratio	-0.03	-0.96	-0.94	-0.93	-0.96	-0.97	-0.98	-0.98
Sales (incl Mfr)	0.97	0.97	0.98	0.98	0.97	0.98	0.97	0.98
Wedge	0.86	0.68	0.61	0.59	0.70	0.67	0.59	0.59
Correlations:								
IP and IPs*	0.60	0.35	0.35	0.47	0.31	0.35	0.40	0.40
L and Ls*	0.39	0.49	0.49	0.78	0.39	0.49	0.60	0.39
C and Cs*	0.38	0.56	0.62	0.65	0.53	0.51	0.70	0.57
X and Xs*	0.33	0.09	0.15	0.63	-0.06	0.16	0.16	0.21
IS and Sales	-0.13	-0.91	-0.89	-0.91	-0.90	-0.92	-0.98	-0.98
Total Investment and NII	0.87	0.56	0.58	0.61	0.54	0.56	0.55	0.50
Exports and Imports	0.85	0.63	0.45	0.58	0.64	0.59	0.33	0.30
TOT and RER	-0.16	1.00	1	1.00	1.00	1.00	0.99	1.00
NIIY AND I_eqpt	0.47	0.04	0.06	0.11	0.02	0.04	0.02	-0.03
Wedge and TOT	0.09	0.24	0.16	0.12	0.24	0.23	0.52	0.53
Wedge and Imports	0.88	0.86	0.89	0.86	0.87	0.86	0.80	0.81