The Dance of the Dynamics: The Interplay of Trade and Growth

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Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Introduction

1. Use "2nd-generation" [i.e., latest vintage] fully endogenous growth model to study interaction of
   - Ricardian trade
   - Economic growth
2. Model built to be consistent with several facts from IO and trade literatures
3. Large number of results
   - A few confirm some conclusions from previous literature
   - Most are new

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Motivation

1. Simple intellectual curiosity
   - 2nd-gen growth model empirically successful
   - Different predictions from its predecessors
   - Not previously used to study trade and growth
2. Existing growth theory cannot explain several salient facts, such as:
   - Systematic difference between industrialized and non-industrialized effects of 1980s globalization
   - Persistent failure of sub-Saharan Africa to share in world-wide increases in growth rates

Table 1
Globalization & Growth
(annualized per capita growth rates, percentage points)

	Years		
Region	1960-1980	1980-2000	Change
World	2.5	2.7	0.2
Industrialized	3.3	1.6	-1.7
Non-industrialized	2.3	2.8	0.5

Source: Bhalla (2002), Table 2.1

Table 4
Rates of Growth of GDP/Capita
(annual avg. growth rates)

Region	*Years* 1000-1500	1500-1820	1820-1870	1870-1913	1913-1950	1950-1973	1973-1998
W. Eur.	0.13	0.15	0.95	1.32	0.76	4.08	1.78
US		0.36	1.34	1.82	1.61	2.45	1.99
Japan	0.03	0.09	0.19	1.48	0.89	8.05	2.34
Asia\Jap	0.05	0.00	-0.11	0.38	-0.02	2.92	3.54
Africa	-0.01	0.01	0.12	0.64	1.02	2.07	0.01

Source: Maddison (2001), Table B-22.

What This Paper Does

Trade & Growth

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Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

1. Extend 2nd-generation growth model to include Ricardian trade
2. Model is built to be consistent with several facts from IO and trade literatures, *not* to explain the foregoing facts
3. Derive many implications, most of which are new
4. Show that the model *does* explain the foregoing facts
5. Test other implications of the model

Relation to Other Trade Models

1. Melitz
   - Superficial similarity: Both emphasize economy's IO structure
   - Aspects differ
     - Melitz: Cross-firm heterogenity in TFP
       *Trade has only transitory growth effect
     - Ji & Seater: Nature of R&D and which firms do it
       *Trade has permanent growth effect
2. Eaton & Kortum
   - Richer trade dimensions (arbitrary numbers of countries and goods)
   - Weaker growth dimension (either static model or empirically-rejected growth models)

Preview of Main Results

Trade Affects Growth

1. Trade changes IO structure and so changes growth
2. Effect can be positive or negative: possible dynamic inefficiency
3. Effective technology transfer

Growth Affect Trade

1. Full characterization of Ricardian corner: One country specializes, one does not
2. Endogenous changes in trading regimes: Can move out of Ricardian corner endogenously

Model Specification

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

IO Facts

1. Number of firms and their market size are endogenous
2. R&D drives technical progress, which drives growth
3. Virtually every country does R&D
4. R&D by multinationals small percentage of total and nearly exclusively specific to host country
5. Three broad classes of R&D: (a) quality improvement, (b) cost reduction, (c) variety expansion
6. All three types of R&D done mostly by incumbent firms
7. Incumbents' R&D devoted mostly to quality improvement
8. Remaining private R&D done mostly by outsiders to develop new varieties (*not* the usual "creative destruction" of 1st-generation endogenous growth theory)

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Model Specification

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Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Model Specification

IO Facts

1. Number of firms and their market size are endogenous
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Trade & Growth

Ji & Seater

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Model Specification

IO Facts

1. Number of firms and their market size are endogenous
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Model Specification

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

IO Facts

1. Number of firms and their market size are endogenous
2. R&D drives technical progress, which drives growth
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Model Specification

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

IO Facts

1. Number of firms and their market size are endogenous
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Model Specification

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

IO Facts

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Underlying Facts, Continued

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Trade Facts

1. About 3/4 of international trade is in factors of production (physical capital and intermediate goods)
2. Some firms or industries shut down in the face of foreign competition - a property of most Ricardian trade models because that's what specialization means

Production

Competitive sectors

Final Goods

$Y = X_1^{\epsilon} X_2^{1-\epsilon}$
where $Y \equiv$ final output, $X_i \equiv i$th processed good

Processed Goods

$$X_1 = \int_0^{N_1} G_{1j}^{\lambda} \left(Z_{1j}^{\delta} Z_1^{\gamma} Z_2^{1-(\delta+\gamma)} l_{1j} \right)^{1-\lambda} dj, \quad 0 < \lambda, \gamma, \delta < 1$$

$$X_2 = \int_0^{N_2} G_{2j}^{\lambda} \left(Z_{2j}^{\delta} Z_2^{\gamma} Z_1^{1-(\delta+\gamma)} l_{2j} \right)^{1-\lambda} dj, \quad 0 < \lambda, \gamma, \delta < 1$$

where N_i = number of varieties of type i intermediate, G_{ij} = quantity of ij variety, Z_{ij} = quality of ij variety, Z_i = average quality of all type i intermediates, l_{ij} = labor assigned to good G_{ij}

Production, Continued

Monopolistically competitive sector

Intermediate Goods

1. Incumbents
   - Output:

$$G_{ij} = A_i^{-1} Y_{ij}$$

   - Quality improvement:

$$\dot{Z}_{ij} = \alpha_i R_{ij}$$

where R_{ij} is R&D expenditure

Production, Continued

Intermediate Goods, Continued

2. Entrants

- Dividend paid by intermediate goods firm:

$$D_{ij} = G_{ij} \left(P_{G_{ij}} - A_i \right) - \phi_i - R_{ij}$$

where ϕ_i is fixed operating cost, which we assume has the form $\phi_{ij} = \theta_i Z_i^2 / Z_k$

- Value of intermediate goods firm:

$$V_{ij}(t) = \int_t^{\infty} D_{ij} \left(\tau \right) e^{-\int_t^{\tau} r(s) ds} \, d\tau$$

- Costless entry induces entry until: $V_{ij} = 0$
- $\Rightarrow D_{ij} = 0, \qquad \Rightarrow R_{ij} = G_{ij} \left(P_{G_{ij}} - A_i \right) - \phi_i$

Summary of Types of Goods

1. Final good Y
2. Processed goods X_1 and X_2
3. Intermediate goods:
   - N_1 varieties of Type-1 goods G_{1j} with quality Z_{1j}
   - N_2 varieties of Type-2 goods G_{2j} with quality Z_{2j}

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Households

Maximize

$$U(t) = \int_t^\infty log(c)\, e^{-\rho t}$$

subject to

$$0 = \int_0^\infty \left(\int_0^{N_1} D_{1j} dj + \int_0^{N_2} D_{2j} dj + wL - C \right) e^{-\int_t^\tau r(s)ds} dt$$

Trade

1. Two countries, Home and Foreign
2. Two sets of tradable goods, G_{1j} and G_{2j}
3. Countries are "large" because intermediate goods industries set prices, not take them as given
4. Final good Y not tradable (see companion paper by Kane, Ji, & Seater for tradable Y)
5. Y_H is the numeraire: $P_{Y_H} \equiv 1$

Comparative Advantage

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

1. Comparative advantage determined by relative quality-adjusted prices
2. Arbitrarily assume Home and Foreign have comparative advantages in G_{1j} and G_{2j}, respectively:

$$\frac{\mathbf{P_{G_{H1}}}}{\mathbf{Z_{H1}}^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}}} \leq \frac{\mathbf{P_{G_{F1}}}}{\mathbf{Z_{F1}}^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}}} \quad \textbf{and} \quad \frac{\mathbf{P_{G_{H2}}}}{\mathbf{Z_{H2}}^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}}} \geq \frac{\mathbf{P_{G_{F2}}}}{\mathbf{Z_{F2}}^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}}}$$

3. Equivalent to

$$\frac{A_{H2}}{A_{F2}}\left(\frac{Z_{F2}}{Z_{H2}}\right)^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}} \geq P_{Y_F} \geq \frac{A_{H1}}{A_{F1}}\left(\frac{Z_{F1}}{Z_{H1}}\right)^{\frac{(\delta+\gamma)(\mathbf{1}-\lambda)}{\lambda}}$$

4. P_{Y_F} must be in this closed interval because otherwise one country tries to import both goods from the other country

Model Solution

1. Intermediate goods prices are constant markups over marginal cost:

$$P_{G_{ij}} = \frac{A_i}{\lambda} \equiv P_{Gi}$$

2. Symmetry across firms within an industry implies same R&D expenditure for each firm in that industry:

$$R_{ij} = R_i$$

3. Other main properties of the solution depend on whether the economy is in the Ricardian interior (each country specializes in producing one group of intermediate goods) or the corner (one country specializes but the other does not)

Complete Specialization

1. Cobb-Douglas technology and trade balance imply

$$P_{Y_F} = [(1-\epsilon)\, L_H/\epsilon L_F]^{1-\lambda}$$

2. Substitution into comparative advantage expression gives

$$\frac{A_{H2}}{A_{F2}}\left(\frac{Z_{F2}}{Z_{H2}}\right)^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}} > \left[\frac{(1-\epsilon)\, L_H}{\epsilon L_F}\right]^{1-\lambda} > \frac{A_{H1}}{A_{F1}}\left(\frac{Z_{F1}}{Z_{H1}}\right)^{(\delta+\gamma}$$

   where the ***strict inequalities are equivalent to complete specialization***

3. Home shuts down its G_2 industry, and Foreign shuts down G_1, so Home and Foreign also shut down the associated R&D programs
4. Growth of Z_{H2} and Z_{F1} stops
5. $\Rightarrow$ complete specialization is dynamically stable

No Aggregate Market Size Effects

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Rate of return to R&D depends on market size per intermediate goods firm, not aggregate market size:

$$\begin{aligned} r_{H1} &= \Omega^H_{r1}\left\{\left[A_1^{\epsilon}A_2^{(1-\epsilon)}\right]^{-\lambda/(1-\lambda)} l_{H1}\right\} \\ &= \Omega^H_{r1}\left\{\left(\sim \frac{G_{H1}}{worker}\right)(workers\ using\ G_{H1})\right\} \\ &= \Omega^H_{r1}\left\{total\ demand\ for\ G_{H1}\right\} \end{aligned}$$

where

$$\begin{aligned} l_{H1} &= L_H/N_{H1} \\ N_{H1} &= \Omega^H_{N1}\left\{\left[A_1^{\epsilon}A_2^{(1-\epsilon)}\right]^{-\lambda/(1-\lambda)} L_H\right\} \end{aligned}$$

$$\Rightarrow \quad r_{H1} = \Omega^H_{r1}/\Omega^H_{N1}$$

Level Effect

$$
\begin{aligned}
Y_H^{Autarky} &= \kappa_H' \left[\left(\frac{Z_{H1}^{\delta+\gamma}}{P_{G_{H1}}^{\frac{\lambda}{1-\lambda}}} \right) Z_{H2}^{1-(\delta+\gamma)} \epsilon \right]^{\epsilon} \\
&\bullet \left[\left(\frac{Z_{H2}^{\delta+\gamma}}{P_{G_{H2}}^{\frac{\lambda}{1-\lambda}}} \right) Z_{H1}^{1-(\delta+\gamma)} (1-\epsilon) \right]^{1-\epsilon} L_H \\
Y_H^{Trade} &= \kappa_H' \left[\left(\frac{Z_{H1}^{\delta+\gamma}}{P_{G_{H1}}^{\frac{\lambda}{1-\lambda}}} \right) Z_{F2}^{1-(\delta+\gamma)} \epsilon \right]^{\epsilon} \\
&\bullet \left[\left(\frac{Z_{F2}^{\delta+\gamma}}{P_{G_{F2}}^{\frac{\lambda}{1-\lambda}}} \right) Z_{H1}^{1-(\delta+\gamma)} (1-\epsilon) \right]^{1-\epsilon} L_H
\end{aligned}
$$

Balanced Growth Rate

1. Everything grows at same rate:

$$g^{\star} = \frac{\dot{Z}_1}{Z_1} = \frac{\dot{Z}_2}{Z_2} = \frac{\dot{Y}}{Y} = \frac{\dot{C}}{C} = \frac{\dot{X}_1}{X_1} = \frac{\dot{X}_2}{X_2} = \frac{\dot{G}_1}{G_1} = \frac{\dot{G}_2}{G_2} = \frac{\dot{w}}{w}$$

2. Autarkic growth rates differ across countries:

$$(g_k^*)^{Autarky} = \frac{\delta}{1-\delta}\sqrt{\alpha_{k1}\theta_{k1}\alpha_{k2}\theta_{k2}} - \frac{1}{1-\delta}\rho$$

3. Trade growth rate:

$$(g_H^{\star})^{Trade} = (g_F^{\star})^{Trade} = \frac{\delta}{1-\delta}\sqrt{\alpha_{H1}\theta_{H1}\alpha_{F2}\theta_{F2}} - \frac{1}{1-\delta}\rho$$

Transition Growth Rate

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

$$(g_H)^{Trade} = (g_F)^{Trade} = \Gamma \frac{\dot{Z}_{H1}}{Z_{H1}} + (1 - \Gamma) \frac{\dot{Z}_{F2}}{Z_{F2}}$$

where

$$\Gamma \equiv [1 - (\delta + \gamma)] + \epsilon [2(\delta + \gamma) - 1]$$

Incomplete Specialization

1. Recall comparative advantage conditions

$$\frac{A_{H2}}{A_{F2}}\left(\frac{Z_{F2}}{Z_{H2}}\right)^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}} \geq P_{Y_F} \geq \frac{A_{H1}}{A_{F1}}\left(\frac{Z_{F1}}{Z_{H1}}\right)^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}}$$

2. In the interior, also have

$$P_{Y_F} = \left[(1-\epsilon)\, L_H/\epsilon L_F\right]^{1-\lambda}$$

3. Nothing guarantees that $\left[(1-\epsilon)\, L_H/\epsilon L_F\right]^{1-\lambda}$ is inside the comparative advantage bounds
4. When it isn't, we have a corner solution, such as

$$\begin{aligned}\left[\frac{(1-\epsilon)\, L_H}{\epsilon L_F}\right]^{1-\lambda} &> \frac{A_{H2}}{A_{F2}}\left(\frac{Z_{F2}}{Z_{H2}}\right)^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}} = P_{Y_F} \\ &> \frac{A_{H1}}{A_{F1}}\left(\frac{Z_{F1}}{Z_{H1}}\right)^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}}\end{aligned}$$

Levels & Growth Rates

1. Level effects essentially the same as under complete specialization
2. Balanced growth rates:

$$g_i^{*T} = \frac{\delta}{1-\delta}\sqrt{\alpha_{H1}\theta_{H1}\left(\alpha_{H2}\theta_{H2}\right)^{\eta}\left(\alpha_{F2}\theta_{F2}\right)^{1-\eta}} - \frac{\rho}{1-\delta}$$

3. Transition growth rates differ in general:

$$\begin{aligned} g_H^T \quad = \quad & \Gamma\frac{\dot{Z}_{H1}}{Z_{H1}} + \left\{\eta\epsilon\left[1-(\delta+\gamma)\right] + (\delta+\gamma)(1-\epsilon)\right\}\frac{\dot{Z}_{H2}}{Z_{H2}} \\ & + \left\{(1-\eta)\left[1-(\delta+\gamma)\right]\epsilon\right\}\frac{\dot{Z}_{F2}}{Z_{F2}} \end{aligned}$$

$$g_F^T = \Gamma\frac{\dot{Z}_{H1}}{Z_{H1}} - (\delta+\gamma)\,\epsilon\frac{\dot{Z}_{H2}}{Z_{H2}} + \left\{\left[1-(\delta+\gamma)\right]\epsilon+\delta\right\}\frac{\dot{Z}_{F2}}{Z_{F2}}$$

Transition Dynamics, Continued

Three phases in the region of $\{Z_{H1}, Z_{H2}, Z_{F2}\}$ space:

1. Saddle-path stable steady state (the balanced growth rate given on previous slide)
2. Phase that reaches the boundary of the interior and crosses into it in finite time, converting the world to complete specialization
3. Phase where world remains incompletely specialized forever and countries growth rates approach constant difference

$$(g_H - g_F) \to \left(\delta + \frac{\delta^2}{\eta\epsilon\left[1 - (\delta + \gamma)\right] + \gamma}\right)\alpha_{H2}\theta_{H2}\left(\frac{Z_{H2}}{Z_{H1}}\right)^*$$

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Model Mechanics

Comparative advantage determines:

1. Trade pattern - who trades what for what
2. Specialization pattern - who produces what

IO structure:

1. prevents aggregate market size effects through proper treatment of entry
2. determines which firms do R&D

Comparative advantage and IO structure interact to determine:

1. Cross-country R&D pattern
2. Countries' and world's growth rates

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

How Trade Affects Growth

$$(g^{\star})^{Trade} = \frac{\delta}{1-\delta}\sqrt{\alpha_{H1}\theta_{H1}\alpha_{F2}\theta_{F2}} - \frac{1}{1-\delta}\rho$$

$$(g)^{Trade} = \Gamma\frac{\dot{Z}_{H1}}{Z_{H1}} + (1-\Gamma)\frac{\dot{Z}_{F2}}{Z_{F2}}$$

$$\text{where} \quad \Gamma \equiv [1-(\delta+\gamma)] + \epsilon\,[2(\delta+\gamma)-1]$$

1. Growth driven entirely by quality improvement, not variety expansion
2. Growth depends on
   - R&D efficiencies α_{ij} and fixed cost parameters θ_{ij}
   - but not quality levels Z_{ij} or unit costs A_{ij} of producing G_{ij}
3. Technology transfer has no effect on balanced growth and only quantitative effects on transitional growth
4. Effective technology transfer has a central effect on both balanced growth and transitional growth

Trade & Growth

Ji & Seater

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

How Trade Affects Growth, Continued

Effective Technology Transfer

1. Generalizes Acemoglu & Ventura (2002): growth rates equal everywhere in Ricardian interior, not just on BGP
2. Can explain observed negative "forward spillovers" in importing country
3. Offers alternative explanation for apparent technology transfer with trade (Coe & Helpman 1995)

Growth Rate Behavior

1. Growth rates equalize irrespective of resource endowment, in contrast to Grossman & Helpman (1991, Ch7)
2. No country takes over all R&D, consistent with observation and contrary to G&H (1991, Ch9)

Dynamic Inefficiency

1. Trade may reduce growth through a dynamic inefficiency arising from a cross-functional externality
   - Trade today depends on comparative advantage, which depends on relative quality-adjusted price
   - Growth depends on R&D, which is independent of comparative advantage but does depend on which industries survive
2. Different from other (counterfactual) explanations of negative growth effect:
   - Redding (1999)
     - exogenous growth
     - no R&D
   - Grossman & Helpman (1990)
     - independent R&D sector
     - growth falls only if resources devoted to R&D fall

Melitz and Eaton-Kortum

$$(g^{\star})^{Trade} = \frac{\delta}{1-\delta}\sqrt{\alpha_{H1}\theta_{H1}\alpha_{F2}\theta_{F2}} - \frac{1}{1-\delta}\rho$$

1. Melitz heterogeneity
   - Affects average efficiency of production $= A_{ij}^{-1}$
   - Irrelevant to long-run growth
   - Recent evidence (Harrison *et al.*, 2013) finds Melitz heterogeneity has only transitional effects
2. Eaton-Kortum
   - Very rich
   - Extensions to growth limited to (counterfactual) 1st-generation endogenous growth and semi-endogenous growth models
   - Naito (2015) shows that growth implications are sensitive to the 1st-generation growth model used: Acemoglu & Ventura (2002) 3-sector model vs. Baldwin & Robert-Nicoud (2008) variety-expansion model
   - Don't know what would happen if combined with 2nd-generation approach

Incomplete Specialization

Three sub-regions

1. F grows faster than H
   - eventually F becomes "technologically big enough" to satisfy all of H's needs
   - world enters the Interior
   - growth rates become equal
2. H grows faster than F
   - H and F go asymptotically to constant difference in growth rates
   - Remain in Ricardian corner forever
   - F's share of world output goes asymptotically to zero
3. Saddle-path stable balanced growth
   - H and F have same growth rate
   - Remain in Ricardian corner forever with incomplete specialization

Terms of Trade

1. Terms of trade are relative quality-adjusted prices

$$TOT \equiv \left(\frac{P_{GH1}}{Z_{H1}^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}}} \right) \left(\frac{P_{GF2}}{Z_{F2}^{\frac{(\delta+\gamma)(1-\lambda)}{\lambda}}} \right)^{-1} = \frac{P_{GH1}}{P_{GF2}} \left(\frac{Z_{F2}}{Z_{H1}} \right)^{(\delta+}$$

2. Can show there is no necessary relation between growth and change in TOT
3. Sharp contrast to Acemoglu & Ventura (2002), where change in TOT is positively related to growth rate

How Growth Affects Trade

1. Growth can move world from Ricardian corner to Ricardian interior endogenously
2. Theory explains the conditions required for this to happen or not happen
3. Brings the two cases together in a unified treatment

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Welfare

$$\begin{aligned} log\frac{u_H^T(t)}{u_H^A(t)} &= (1-\epsilon)\,log\left[\frac{Z_{F2}^{\delta+\gamma}(0)}{P_{G_{F2}}^{\frac{\lambda}{1-\lambda}}} - \frac{Z_{H2}^{\delta+\gamma}(0)}{P_{G_{J2}}^{\frac{\lambda}{1-\lambda}}}\right] \\ &+\epsilon(1-\delta-\gamma)\left[log\,Z_{F2}(0) - Z_{H2}(0)\right] \\ &+\left\{\Gamma\int_o^{\infty}\left[g_{H1}^T(s) - g_{H1}^A\right]ds \right. \\ &\left. +(1-\Gamma)\int_o^{\infty}\left[g_{F2}^T(s) - g_{H2}^A\right]ds\right\} \end{aligned}$$

1. 1st term is static gain from trade
2. 2nd term also a static term reflecting externality due to quality spillover across industries
3. 3rd term is the welfare change from change in growth rate

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Table 1
Globalization & Growth
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World	2.5	2.7	0.2
Industrialized	3.3	1.6	-1.7
Non-industrialized	2.3	2.8	0.5

Source: Bhalla (2002), Table 2.1

Reconciliations, Continued

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Our theory reconciles competing views

1. Sachs & Warner (1995): trade is good for growth
2. Rodriguez & Rodrik (2000): trade has no systematic effect on growth

Reconciliations, Continued

Table 4
Rates of Growth of GDP/Capita
(annual avg. growth rates)

Region	*Years* 1000-1500	1500-1820	1820-1870	1870-1913	1913-1950	1950-1973	1973-1998
W. Eur.	0.13	0.15	0.95	1.32	0.76	4.08	1.78
US		0.36	1.34	1.82	1.61	2.45	1.99
Japan	0.03	0.09	0.19	1.48	0.89	8.05	2.34
Asia\Jap	0.05	0.00	-0.11	0.38	-0.02	2.92	3.54
Africa	-0.01	0.01	0.12	0.64	1.02	2.07	0.01

Source: Maddison (2001), Table B-22.

Reconciliations, Continued

Trade & Growth

Ji & Seater

Introduction

Model Specification

Model Solution

Interpretations, Implications, & Comparisons

Welfare

Reconciliations & Tests

Conclusion

Our theory can explain

1. Asia's catch-up
   - Japan 1870-1950
   - Japan 1950-1998 (?)
2. Africa's failure to catch up
3. Quah's (1997) "twin peaks"

Tests

We perform three simple tests

1. Terms of trade and growth
2. Globalization and growth
3. Trade and growth differences among growth leaders and followers

Tests: Terms of Trade & Growth

Table 5

Growth rates of income and of the terms of trade

	Growth rate of income per worker			
	Coeff.	Std err	t-stat	p-val
Constant	0.01975	0.0013	15.7974	0.0000
Growth rate of TOT	0.01161	0.0661	0.1758	0.8609
Adj R-squared	-0.0111			

Tests: 1980s Globalization

Trade & Growth
Ji & Seater
Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Refine Bhalla's test by seeing how many advanced and laggard economies had an increase or decrease in growth rates after 1980

Table 6
Globalization and Growth Rates

	Change in growth rate	
	Rise	Fall
Member OECD	1	28
Non-member OECD	15	45
Developed	0	24
Underdeveloped	16	49

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

Tests: Leaders vs Laggards

1. Howitt & Mayer-Foulkes (2005) prediction:

   Increase in technology transfer caused by trade raises leaders' growth rates and reduces laggards' growth rates to zero

2. Our prediction:

   Trade and effective technology transfer raise laggards' growth rates

3. Our test:
   - Compare change in growth rates in two sets of countries
     1. initially more than 1 percentage point above world average
     2. initially more than 1 percentage point below world avarage
   - Of the 20 countries in Low group, 19 had growth rates higher in last 5 years of sample than in first 5 years

Conclusion

Introduction
Model Specification
Model Solution
Interpretations, Implications, & Comparisons
Welfare
Reconciliations & Tests
Conclusion

1. Built model on IO and trade facts
2. Theory delivers many results either new or contrary to existing literature
3. Theory's predictions consistent with several observations and three simple tests
4. Work for the future: Generalize to many countries and many goods