The Role of Trade in Structural Transformation

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Introduction

- High agricultural productivity growth is typically considered a necessary condition for the start of industrialization and growth. Schultz (1953); Gollin, Parente, Rogerson (2007).

- Goal of the paper:
  - Can international trade in agricultural good accelerate transition process of countries with low agricultural productivity?
  - What is the quantitative effect of trade on the structural transformation of net agricultural importers?

- Main idea:
  - Under autarky, because of need to feed population:
    - Low agricultural productivity $\Rightarrow$ Large agricultural sector, low aggregate productivity.
  - Under international trade:
    - Low agricultural productivity $\Rightarrow$ Food imports from abroad, faster structural transformation.

Main Contributions

- Related literature:
  - Structural transformation in closed economy:
    Gollin, Parente, Rogerson (2007); Hayashi and Prescott (2008).
  - Structural transformation in an open economy:
    Matsuyama (1992, 2009); Stokey (2001); Yi and Zhang (2010).
- Main contributions of this paper:
  - Introduce trade into two-sector neo-classical growth model.
  - Show model is able to replicate structural transformation data:
    - Closed Economy model: United States 1890-2007.
    - Open Economy: United Kingdom 1800-1900, S. Korea 1963-2007.
  - Quantitatively evaluate role of trade in the transformation of:
    - United Kingdom,
    - South Korea.

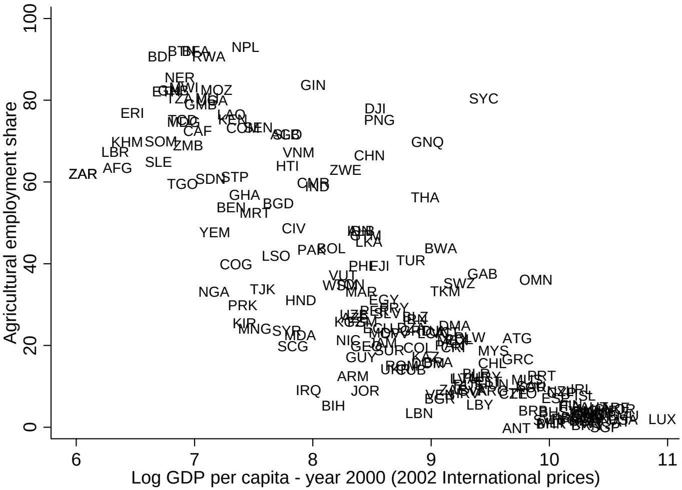
Related Literature

Outline of the presentation

1. Introduction
2. Structural transformation model
3. Model simulation, numerical results
4. Implications for low-development countries
5. Conclusion

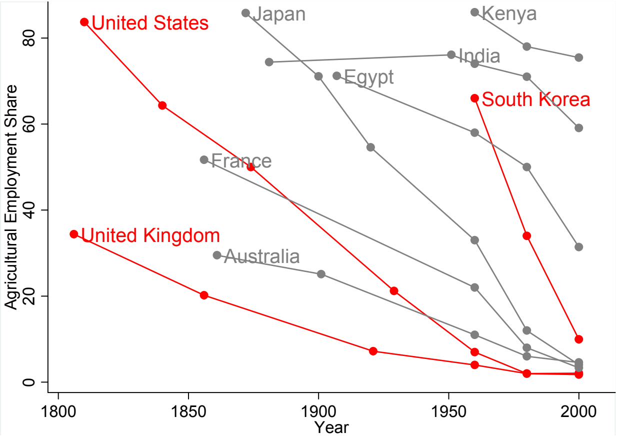
Motivation: income and agriculture size

- Structural transformation is a key element of the development process: poor countries have much larger agricultural sectors than rich ones.



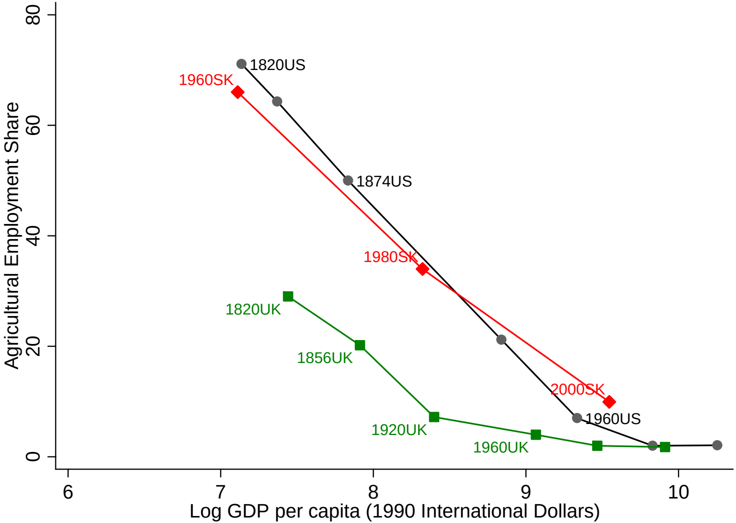
Evidence for US, UK, S. Korea

- Transformation expenciered at very different points in time:
  - United States: Transition during 19th and 20th century.
  - United Kingdom: Transition earlier than in the US.
  - South Korea: Transition 2nd half 20th century, much faster.



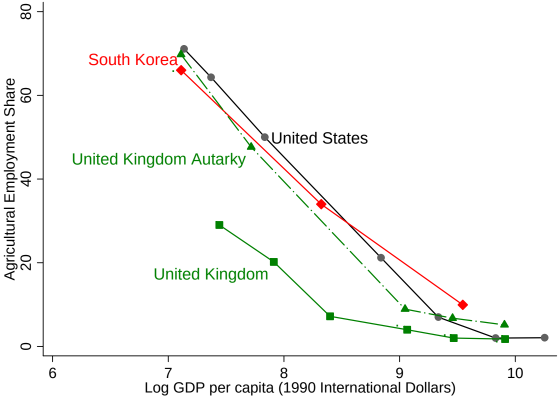
Evidence for US, UK, S. Korea

- Controlling for income, size agricultural sector similar in US and Korea; much smaller in UK.



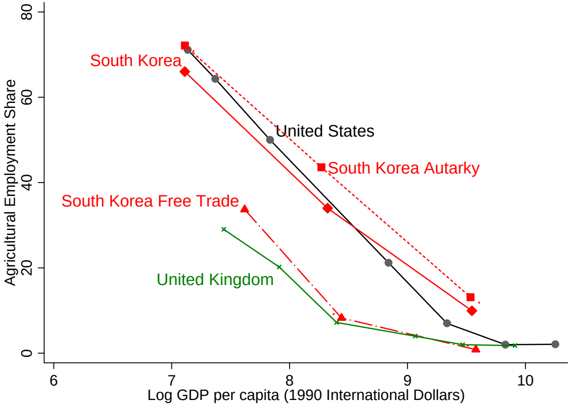
Main Results: United Kingdom

- Trade very important for United Kingdom's early transformation:
  - In 1800, 80% empl in agr under autarky instead of 35% under trade.
- Trade had very large effects on income growth and welfare:
  - Gain in welfare equivalent to 5.5% increase in consumption exp.



Main Results: South Korea

- In South Korea, positive but smaller effects of trade in transformation.
    - Initial agricultural employment 70% instead of 63%.
- If no agr protection, faster transition and lager effects trade:
    - Agricultural employment below 10% in 1979 instead of 2002.
    - Gain in welfare equivalent to 5.4% increase in consumption exp.



Model Description

- Two Sectors:
  - Agricultural good (consumption).
  - Nonagricultural good (consumption and investment).
- Production functions:
  - Agricultural sector inputs: land (fixed), capital, labor.
  - Nonagricultural sector inputs: capital, labor.
  - Exogenous technology growth; different rates across sectors.
- Preferences:
  - Low income elasticity agricultural good.
  - Low price elasticity agricultural good.
- Environment:
  - Perfect competition.
  - Perfect input mobility.

Technology Description

- Production functions:
  - Nonagricultural sector:

$$Y_n = A_n (K_n)^{\alpha} (N_n)^{1-\alpha}$$

  - Agricultural sector:

$$Y_a = A_a (K_a)^{\eta} (N_a)^{\beta} (L)^{1-\eta-\beta}$$

  - Exogenous technological change:

$$\frac{\dot{A}_n}{A_n} \equiv \gamma_n, \quad \frac{\dot{A}_a}{A_a} \equiv \gamma_a$$

- Capital accumulation:

$$\dot{K} = (Y_n - C_n) - \delta K$$

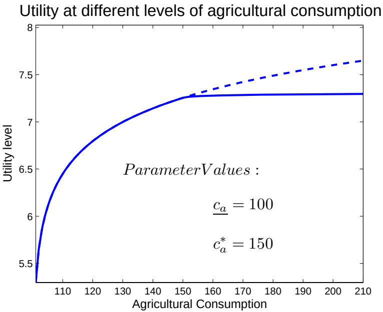
Preferences Description

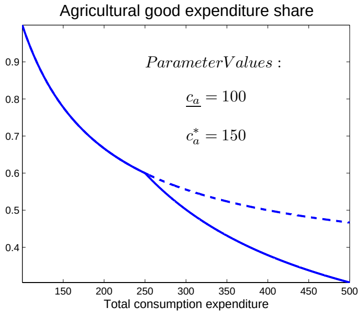
- Preferences:

$$U(t) = \int_t^{\infty} e^{-\rho s} N(s)\, u(c_a, c_n)\, ds$$

$$u(c_a, c_n) = \log(c_n) + \begin{cases} \mu_0 \log(c_a - \underline{c}_a) & \text{if } c_a \leq c_a^* \\ B + \mu_1 \log(c_a - c_a^* - A) & \text{if } c_a > c_a^* \end{cases}$$

- $A = \frac{\mu_1}{\mu_0}(c_a^* - \underline{c}_a)$ to get differentiability at c_a^*.
- $B = \mu_0 \log(c_a^* - \underline{c}_a) - \mu_1 \log\left(\frac{\mu_1}{\mu_0}(c_a^* - \underline{c}_a)\right)$ to get continuity at c_a^*.





Main mechanisms

- Agents optimization:
  - Firms choose capital, labor, and land demand to maximize profits.
  - Households choose savings, consumption, allocation of labor and capital to maximize intertemporal welfare.
- Market clearing:
  - Under autarky, domestic supply = domestic demand.
  - Under trade, imports = exports (labor, capital not mobile).
- Main mechanims leading to structural transformation:
  - Technological change + capital accumulation $\Rightarrow$ income $\uparrow \Rightarrow$ agricultural consumption share $\downarrow$.
  - Structural transformation in a closed economy:
    - Agricultural consumption share $\downarrow \Rightarrow$ agricultural employment share $\downarrow$.
  - Structural transformation in an open economy:
    - If international price agricultural good $<$ domestic price, trade $\Rightarrow$ agricultural imports $\uparrow$, agricultural employment $\downarrow$.

Equilibrium analysis

- If population growth not ”too high” relative to TFP growth,

$$\frac{\eta}{1-\alpha}\gamma_n + \gamma_a - (1-\eta-\beta)\nu > 0,$$

economy behaves asymptotically as if homothetic preferences:

$$u(c_a, c_n) = \mu_1 \log(c_a) + \log(c_n).$$

  - Then, for any initial condition, economy converges asymptotically to the homothetic preferences Balanced Growth Path.

- Closed economy BGP: Closed Economy
  - Positive and constant employment shares in both sectors.
  - Constant (not necessarily equal) growth rates of all other variables.

- Small open economy: Open Economy
  - Specialization in agriculture if agricultural price ”high enough”.
  - BGP growth rates depend on sectoral composition:
    - If growth rate agricultural price ”high enough”, agricultural specialization.
    - If not, non-agricultural specialization.

Simulations

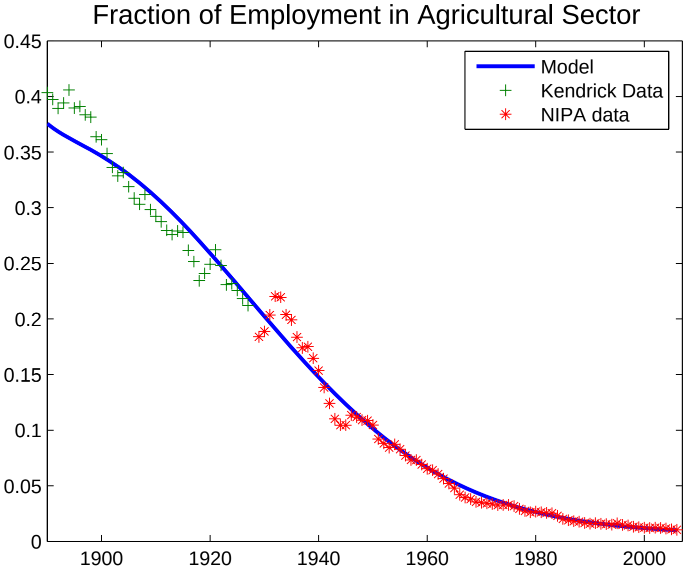
1. Parameter values specified.
2. Exogenous variables specified:
   - United States: A_a, A_n, N.
   - United Kingdom: $A_a, A_n, N, p_a/p_n$.
   - South Korea: $A_a, A_n, N, p_a/p_n, t_a, \sigma_a$.
3. Initial capital stock taken from the data.
4. Simulation results compared with the data.
   - United States: 1890 - 2007.
   - United Kingdom: 1800 - 1900.
   - South Korea: 1963 - 2007.
5. Counterfactual experiments:
   - United States: different initial productivity.
   - United Kingdom: autarky.
   - South Korea: autarky, free trade (no agricultural policy).

Parameter Values

	Description	Value	Source
α	Capital share nonagr sector	1/3	standard
η	Capital share agr sector	0.1	Korea Development Institute
β	Labor share agr sector	0.5	Korea Development Institute
δ	Capital depreciation rate	0.10	Christensen, Jorgenson (1995)
ρ	Intertemporal discount	0.06	To match SS capital US
μ_0	Agr good initial weight	0.5	To match Korea cons data
μ_1	Agr good weight	0.01	To match SS agr empl US
$c_a^*/\underline{c_a}$	Agr cons threshold	1.5	To match Korea cons data
$\underline{c_a}$	Agr subsistence level (as % initial agr cons)	60%	To match US cons data
		85%	To match Korea cons data
		91%	To match UK cons data

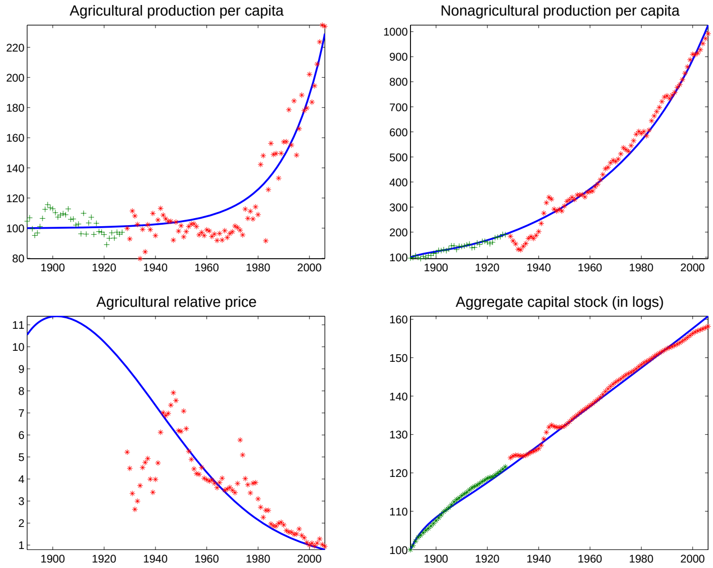
Levels Comparison

United States Baseline Simulation

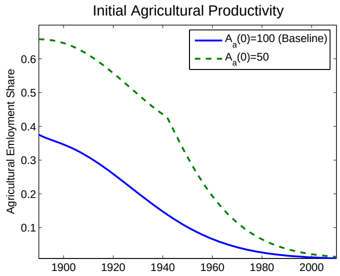


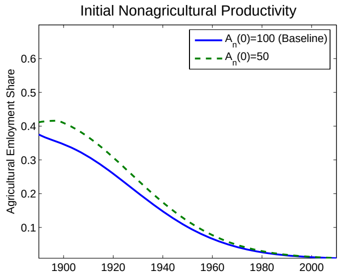
Exogenous Variables

United States Baseline Simulation

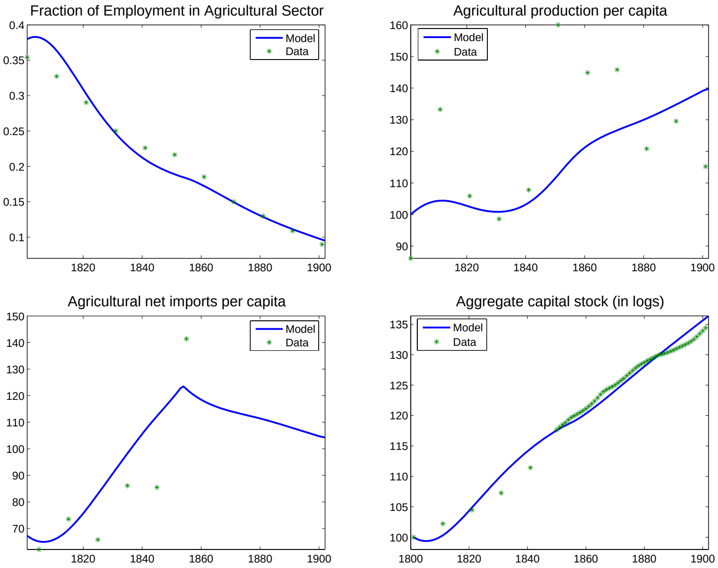


United Sates Simulations: changes in initial TFP



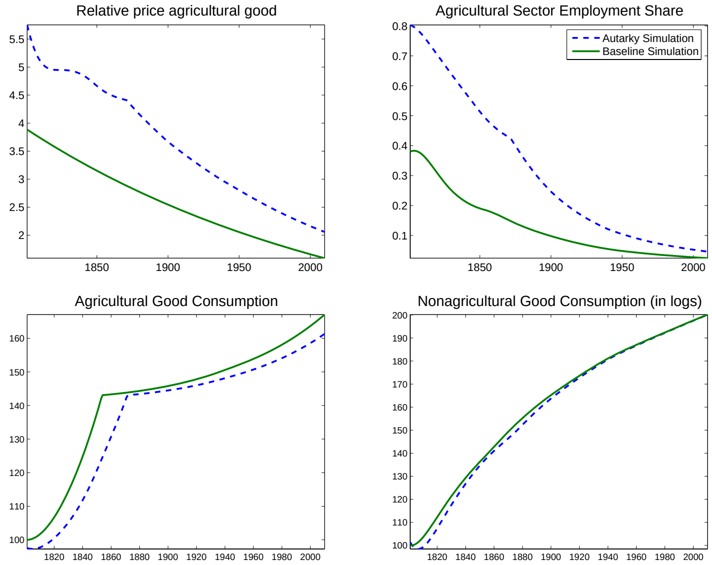


United Kingdom Baseline Simulation



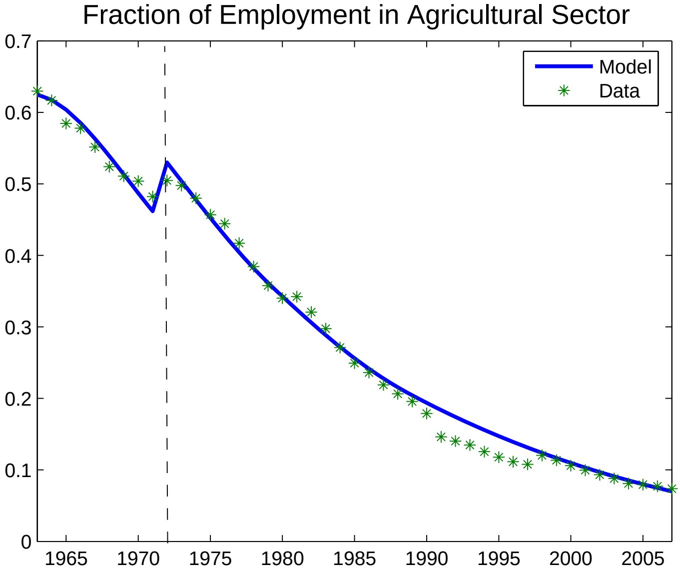
Exogenous Variables

Policy experiment: Autarky



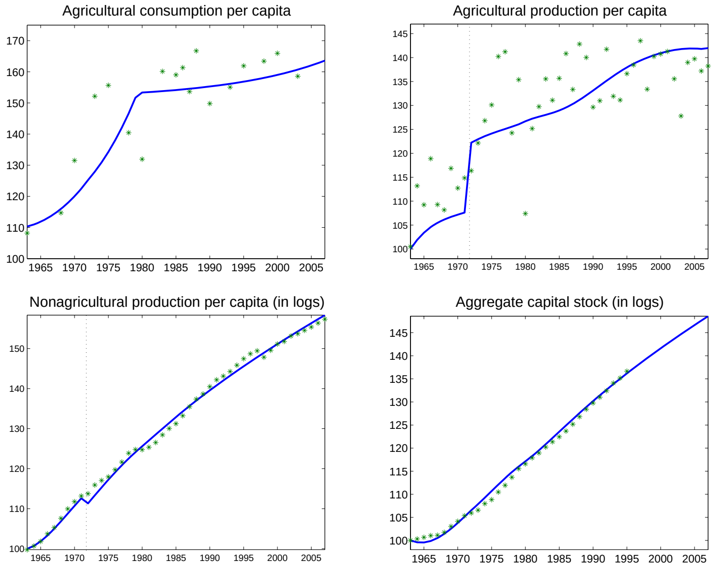
Results Summary

South Korea Baseline Simulation

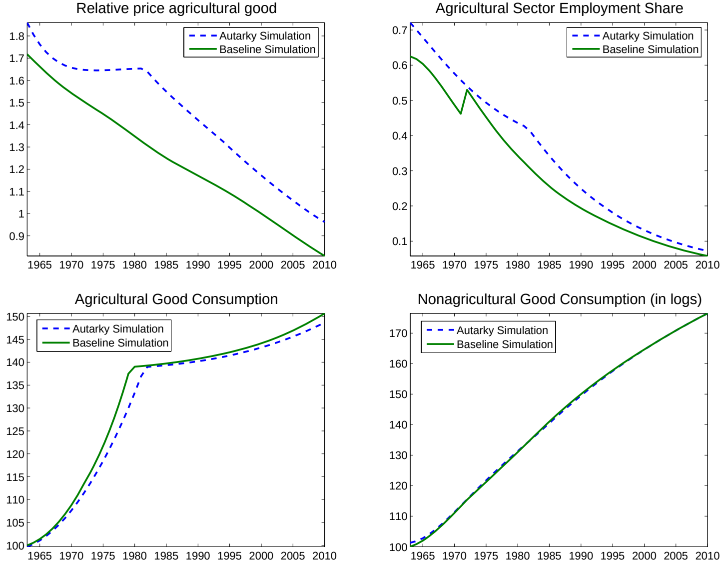


Exogenous Variables

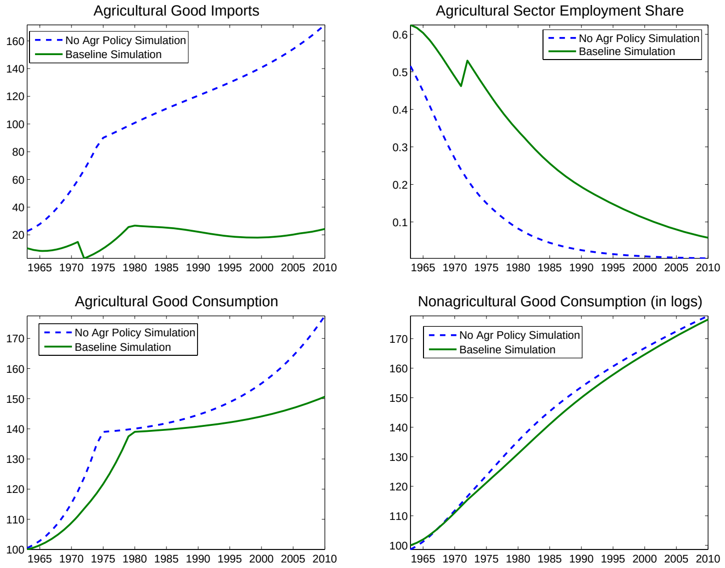
South Korea Baseline Simulation



Policy experiment 1: Autarky



Policy experiment 2: No Agricultural Policy



Results Summary

Results Summary

- Real income growth:

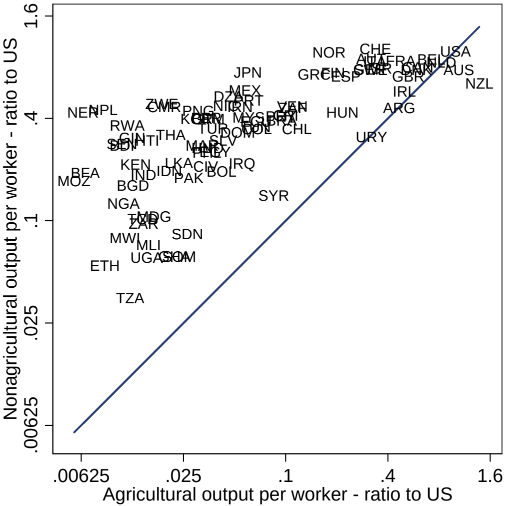
	Autarky	**Baseline**	**No agr policy**
United Kingdom	1.28%	1.44%	
South Korea	4.5%	4.71%	5.47%

- Intertemporal Welfare gain with respect to Autarky: (in terms of annual consumption expenditures)

	Baseline	**No agr policy**
United Kingdom	5.5%	
South Korea	0.4%	5.4%

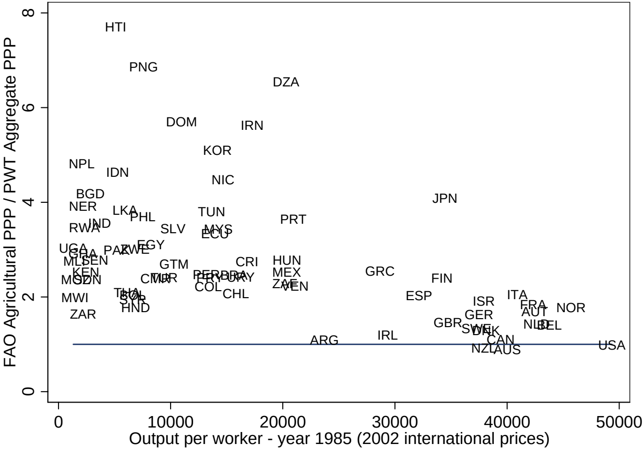
International evidence. Agricultural and non-agricultural productivity

- Poor countries are particularly unproductive in agriculture:



International evidence. Agricultural relative price

- The relative price of agricultural goods is higher in poor countries:



Implications for Low-Development Countries

- There seem to be important potential benefits from agricultural imports for many poor countries:

Year: 1985	Ratio 10th - 90th percentile
Agricultural Employment Share	0.85/0.05
Aggregate labor productivity	1/30
Agriculture labor productivity	1/50
Relative price agricultural good	2

- Agricultural trade flows very low in poor countries, but they are more food importers than rich countries. (World Bank, year 2004-05)

	Net Food Exporters	Net food Importers	# Countries
Industrial	39%	61%	33
Middle-income	34%	66%	105
Low income	28%	72%	58

International Evidence

Conclusion

- Results summary:
  - Large effects of trade in United Kingdom.
  - Positive but smaller effects of trade in South Korea.
  - Trade effects in South Korea much larger if no agriculture protection.

- Policy implications:
  Important welfare gains from eliminating agricultural protection policies.

- Future extensions:
  - Robustness analysis (functional forms, parameter values).
  - Study potential benefits of agricultural trade for low-development countries.
  - Examine relation land quality and income for closed and open economies.

APPENDIX

Appendix. Related Literature

- Why countries experience structural transformation:
  - Differences in goods' income elasticities: Kongsamut et al. (2001).
  - Differences in TFP growth across sectors: Ngai, Pissarides (2008).
  - Differences in sectoral factor intensities: Acemoglu, Guerrieri (2008).

- Structural Transformation in a Closed Economy:

  Shin (1990); Echevarria (1997); Laitner (2000); Lucas (2000, 2007); Caselli and Coleman (2001); Gollin, Parente and Rogerson (2002, 2004, 2007); Hansen and Prescott (2002); Hayashi and Prescott (2008); Restuccia, Yang and Zhu (2008).

- Structural Transformation in an Open Economy:

  Matsuyama (1992, 2009); Stokey (2001); Echevarria (2007); Stefanski (2010); Ungor (2010); Deardorf, Park (2010); Yi and Zhang (2010); Betts and Verma (2011); Choi and Ma (2011); Tombe (2011).

- Agricultural vs Nonagricultural productivity:

  Caselli (2005); Cordoba and Ripoll (2006); Vollrath (2008); Lagakos and Waugh (2009).

- East Asian countries growth episodes:

  Young (1992, 1995); Hsieh (2002); Connolly and Yi (2009).

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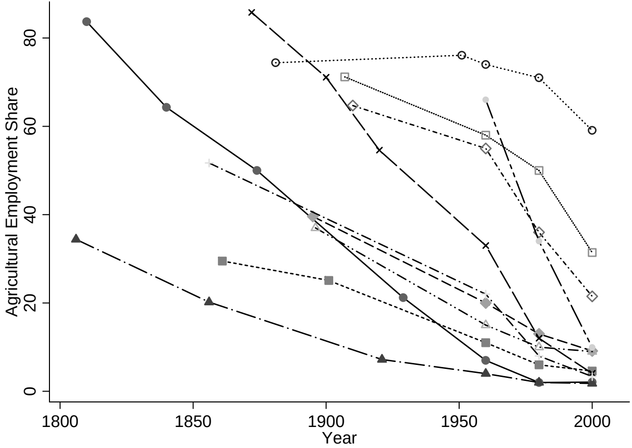
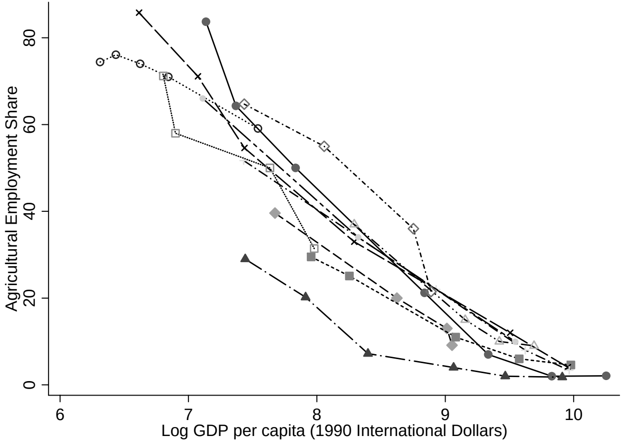
Appendix. Empirical evidence

- Structural transformation experienced by countries at different points in time.



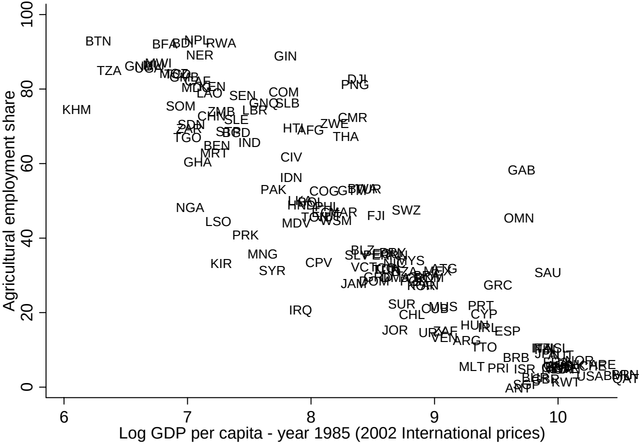
Appendix. Empirical evidence

- Structural transformation process closely related to income growth.



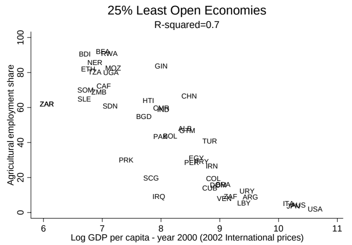
Appendix. Empirical evidence

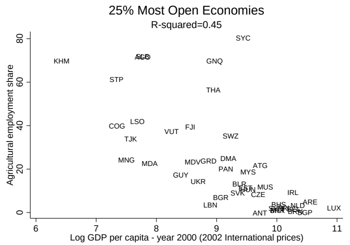
- Also, at a given point in time, negative relation between income and size agriculture across countries :



Appendix. Empirical evidence

- Relationship between income and agricultural sector size less strong for open economies:



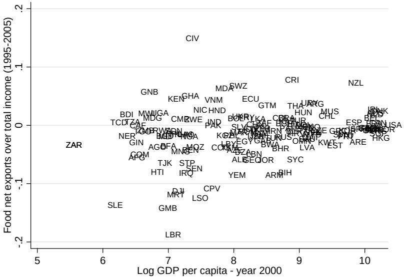


Appendix. Empirical evidence

Back

- Poor countries more likely to be food exporters than rich ones (World Bank, year 2004-05):

	Net Food Exporters	Net food Importers	# Countries
Industrial	39%	61%	33
Middle-income	34%	66%	105
Low income	28%	72%	58



Appendix. Closed Economy Equilibrium

- Households' optimization:

$$\max_{\{c_s,n_s,k_s,\}_{s=a,n}} \int_0^\infty e^{-(\rho-\nu)t} u\left(c_a, c_n\right) dt$$

s.t.

$$\dot{k} = w + p_l L e^{-\nu t} + \left(r - \delta - \nu\right) k - q c_a - c_n$$

- Firms' optimization:

$$\max_{k_n,n_n} \left\{ A_n \left(k_n\right)^\alpha \left(n_n\right)^{1-\alpha} - rk - wn_n \right\}$$

$$\max_{k_a,n_a} \left\{ qA_a \left(k_a\right)^\eta \left(n_a\right)^\beta \left(Le^{-\nu t}\right)^{1-\eta-\beta} - rk_a - wn_a - p_l L e^{-\nu t} \right\}$$

Appendix. Closed economy equilibrium conditions

- Consumers' optimization conditions:

$$\dot{c}_n = c_n \left(r - \delta - \rho \right)$$

$$c_a = \begin{cases} \underline{c_a} + \mu_0 \frac{c_n}{q} & \text{if } \underline{c_a} + \mu_a^0 \frac{c_n}{q} \leq c_a^* \\ c_a^* - A + \mu_1 \frac{c_n}{q} & \text{else} \end{cases}$$

- Firms' optimization conditions:

$$r(t) = q\eta A_a (k_a)^{\eta-1} (n_a)^{\beta} \left(Le^{-\nu t} \right)^{1-\eta-\beta} = \alpha A_n (k_n)^{\alpha-1} (n_n)^{1-\alpha}$$

$$w(t) = q\beta A_a (k_a)^{\eta} (n_a)^{\beta-1} \left(Le^{-\nu t} \right)^{1-\eta-\beta} = (1-\alpha) A_n (k_n)^{\alpha} (n_n)^{-\alpha}$$

- Market clearing:

$$y_a = c_a, \;\; y_n = \dot{k} + (\delta + \nu) k + c_n$$

$$k_a + k_n = k, \;\; n_a + n_n = 1$$

Appendix. Closed Economy Equilibrium

$$u(c_a, c_n) = \mu_1 \log(c_a) + \log(c_n) \tag{1}$$

$$u(c_a, c_n) = \log(c_n) + \begin{cases} \mu_0 \log(c_a - \underline{c_a}) & \text{if } c_a \leq c_a^* \\ B + \mu_1 \log(c_a - c_a^* - A) & \text{if } c_a > c_a^* \end{cases} \tag{2}$$

- If preferences as in equation (1), economy converges asymptotically to BGP.
- If preferences as in equation (2), equilibrium system converges to the equilibrium system for preferences (1), as long as

$$\frac{\eta}{1-\alpha}\gamma_n + \gamma_a - (1 - \eta - \beta)\nu > 0 \tag{3}$$

- For any initial condition, economy converges asymptotically to BGP of preferences (1).

Appendix. Closed economy BGP growth rates

$$\lim_{t\to\infty}\left\{\frac{\dot{s_e(t)}}{s_e(t)}\right\} = 0, \quad \text{where } s_e \equiv \frac{N_a}{N}$$

$$\lim_{t\to\infty}\left\{\frac{\dot{s_k(t)}}{s_k(t)}\right\} = 0, \quad \text{where } s_k \equiv \frac{K_a}{K}$$

$$\lim_{t\to\infty}\left\{\frac{\dot{k(t)}}{k(t)}\right\} = \lim_{t\to\infty}\left\{\frac{\dot{c_n(t)}}{c_n(t)}\right\} = \frac{1}{1-\alpha}\gamma_n$$

$$\lim_{t\to\infty}\left\{\frac{\dot{q(t)}}{q(t)}\right\} = \frac{1-\eta}{1-\alpha}\gamma_n + (1-\eta-\beta)\nu - \gamma_a$$

$$\lim_{t\to\infty}\left\{\frac{\dot{c_a(t)}}{c_a(t)}\right\} = \gamma_a + \frac{\eta}{1-\alpha}\gamma_n - (1-\eta-\beta)\nu$$

Appendix. Autarky equilibrium analysis

- Structural transformation under autarky:
  - Evolution of fraction of employment in agricultural sector:

$$\frac{n_a}{1-n_a} = \mu \frac{\beta}{1-\alpha} \frac{\frac{c_n}{y_n}}{1 - \frac{c_a^* - A}{c_a}}$$

  - If $\frac{c_n}{y_n}$ constant, as c_a increases

$$\frac{c_a^* - A}{c_a} \downarrow \Rightarrow s_e \downarrow$$

- Evolution of agricultural good relative price:

$$q = \Phi \frac{A_n}{A_a} \left(Le^{-\nu t}\right)^{\eta+\beta-1} k^{\alpha-\eta} \frac{(n_a)^{1-\eta-\beta}}{\left(\frac{\beta}{\eta} - n_a \left(\frac{\beta}{\eta} - \frac{1-\alpha}{\alpha}\right)\right)^{\alpha-\eta}}$$

  - Structural transformation has negative effect on agricultural price:

$$n_a \downarrow \Rightarrow q \downarrow$$

  - Other variables also affect agricultural price:

$$\frac{A_n}{A_a} \uparrow \Rightarrow q \uparrow, \;\; k \uparrow \Rightarrow q \uparrow, \;\; Le^{-\nu t} \downarrow \Rightarrow q \uparrow$$

Back

Appendix. Open Economy Equilibrium

- Market clearing conditions:

$$
\begin{aligned}
y_a &= c_a + x_a \\
y_n &= \dot{k} + (\delta + \nu) k + c_n + x_n
\end{aligned}
$$

$$
\begin{aligned}
k_a + k_n &= k \\
n_a + n_n &= 1
\end{aligned}
$$

- Balanced trade:

$$q x_a + x_n = 0 \ \ \forall t$$

- Small open economy:

$$q \text{ exogenous, with } \frac{\dot{q}}{q} \equiv \gamma_q$$

Appendix. Open Economy Equilibrium

- Specialization in the short run:
  - If $q(t)$ is "high enough", specialization in agricultural good:

$$
\begin{aligned}
q &> \lim_{s_e \to 1, s_k \to 1} \left\{ \frac{\alpha A_n \left((1-s_k)\,k\right)^{\alpha-1} \left((1-s_e)\right)^{1-\alpha}}{\eta A_a \left(s_k k\right)^{\eta-1} \left(s_e\right)^{\beta} N^{\eta+\beta-1}} \right\} \\
&= \Theta \frac{A_n}{A_a} N^{1-\eta-\beta} k^{\alpha-\eta}
\end{aligned}
$$

  - Specialization in nonagricultural good not possible in the short run:

$$
\begin{aligned}
q &\nless \lim_{s_e \to 0, s_k \to 0} \left\{ \frac{\alpha A_n \left((1-s_k)\,k\right)^{\alpha-1} \left((1-s_e)\right)^{1-\alpha}}{\eta A_a \left(s_k k\right)^{\eta-1} \left(s_e\right)^{\beta} N^{\eta+\beta-1}} \right\} \\
&= \Psi \frac{A_n}{A_a} N^{1-\eta-\beta} k^{\alpha-\eta} \left(\lim_{s_e \to 0} s_e^{1-\eta-\beta} \right)
\end{aligned}
$$

Appendix. Open Economy Equilibrium

- As before, if condition (3) is satisfied, convergence to BGP of (1).
- Specialization in the long run:
  - If $\gamma_q = (1-\eta-\beta)\nu + \frac{1-\eta}{1-\alpha}\gamma_n - \gamma_a$, no specialization.
  - If $\gamma_q < (1-\eta-\beta)\nu + \frac{1-\eta}{1-\alpha}\gamma_n - \gamma_a$

$$\lim_{t\to\infty}\{n_a(t)\} = \lim_{t\to\infty}\left\{\frac{k_a(t)}{k(t)}\right\} = 0$$

  - If $\gamma_q > (1-\eta-\beta)\nu + \frac{1-\eta}{1-\alpha}\gamma_n - \gamma_a$,

$$\lim_{t\to\infty}\{n_a(t)\} = \lim_{t\to\infty}\left\{\frac{k_a(t)}{k(t)}\right\} = 1$$

Appendix. Open economy BGP growth rates

- If $\gamma_q \leq (1-\eta-\beta)\nu + (1-\eta)\gamma_n - \beta\gamma_a$ (and q not "too high"):

$$\lim_{t\to\infty}\left\{\frac{\dot{k}(t)}{k(t)}\right\} = \lim_{t\to\infty}\left\{\frac{\dot{c}_n(t)}{c_n(t)}\right\} = \frac{1}{1-\alpha}\gamma_n$$

$$\lim_{t\to\infty}\left\{\frac{\dot{c}_a(t)}{c_a(t)}\right\} = \frac{1}{1-\alpha}\gamma_n - \gamma_q$$

- If $\gamma_q > (1-\eta-\beta)\nu + (1-\eta)\gamma_n - \beta\gamma_a$ (or q "high enough"):

$$\lim_{t\to\infty}\left\{\frac{\dot{k}(t)}{k(t)}\right\} = \lim_{t\to\infty}\left\{\frac{\dot{c}_n(t)}{c_n(t)}\right\} = \frac{1}{1-\eta}\gamma_a + \frac{1}{1-\eta}\gamma_q - \frac{1-\eta-\beta}{1-\eta}\nu$$

$$\lim_{t\to\infty}\left\{\frac{\dot{c}_a(t)}{c_a(t)}\right\} = \frac{1}{1-\eta}\gamma_a + \frac{\eta}{1-\eta}\gamma_q - \frac{1-\eta-\beta}{1-\eta}\nu$$

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Comparison subsistence levels

- If good a is tradable and country i imports it from country j, then

$$E(t)P_a^i(t) = P_a^j(t)\left(1+\tau_a^i(t)\right)\left(1+d_a^i(t)\right)$$

where E is the exchange rate, τ the import tariff, and d the transport cost.

- Using this, possible to compare $\underline{c_a}$ for the three countries:
  - Comparison United States, South Korea:

$$\frac{P_a^{us}(1990)\,\underline{c_a}^{sk}}{P_a^{us}(1990)\,\underline{c_a}^{us}} = \frac{\frac{E(1990)P_a^{us}(1990)}{(1+\tau_a^{sk}(1990))(1+d_a^{sk}(1990))}\underline{c_a}^{sk}}{P_a^{us}(1990)\,\underline{c_a}^{us}} = \frac{1.47}{(1+d_a^{sk}(1990))}$$

$\Rightarrow$ If transportation cost equal to 47%, then the two subsistence levels are equivalent.

  - Comparison United States, United Kingdom:

$$\frac{P_a^{us}(1900)\,\underline{c_a}^{uk}}{P_a^{us}(1900)\,\underline{c_a}^{us}} = \frac{\frac{E(1900)P_a^{us}(1900)}{(1+\tau_a^{uk}(1900))(1+d_a^{uk}(1900))}\underline{c_a}^{sk}}{P_a^{us}(1900)\,\underline{c_a}^{us}} = \frac{0.52}{(1+d_a^{uk}(1900))}$$

$\Rightarrow$ Even if no import tariffs and no transportation costs, value subsistence level in UK lower than in US!

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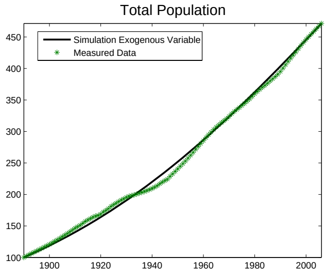
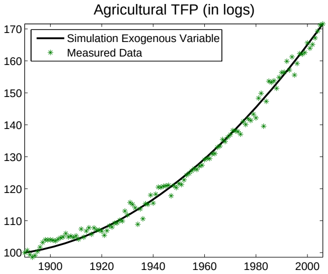
Appendix. United States Exogenous Variables

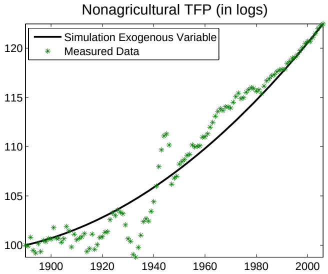
	Description	Sample period growth	Future growth	Data source
ν	Population growth	Smoothed data (0.018 - 0.009)	0.01	Kendrick (1961) NIPA
γ_a	Agr TFP growth	Smoothed data (0.005 - 0.06)	0.06	Kendrick (1961) NIPA
γ_n	Nona TFP growth	Smoothed data (0.002 - 0.015)	0.015	Kendrick (1961) NIPA

	Description	Value	Data source
$K(0)$	Initial capital stock	$\frac{K}{Y_n} = 2.03$ in 1890	Kendrick (1961)

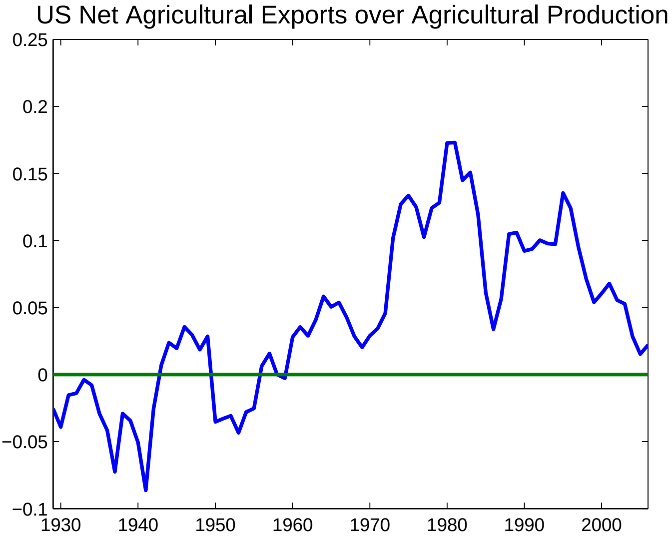
Appendix. United States Exogenous Variables







Appendix. United States Data



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Appendix. South Korea Data

- Why study South Korea?

	Agr emp %	GDP capita (Korea / US) %	Openess (X+M)/GDP)	Agr imports (over Agr GDP) %
1955	80 (approx)	11.3	11.6%	
1965	58.5	11.1	24.22%	7.8
1975	45.7	17.9	62%	19.6
1985	24.9	25.2	64.4%	17.2
1995	11.8	45.4	58.7%	18.5
2004	8.1	51	84%	24.1

Appendix. South Korea exogenous variables

- Agricultural policy variables:
  - Import tariff (iceberg-cost type): t_a
  - Production subsidy: σ_a
  - Lump-sum tax to households: τ
  - Balanced government budget constraint: $\sigma_a q y_a = \tau$

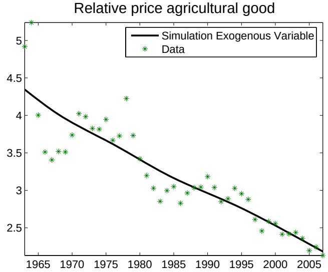
	Description	Value	Data source
σ_a	Agr prod subsidy	0 (1963 - 1972) 10% (1973 - 2007)	To match n_a data
t_a	Agr import tariff		USDA (1990: 104%)

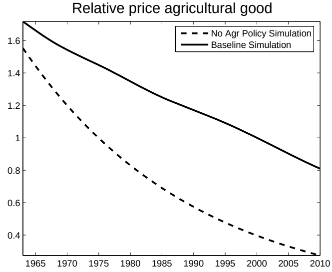
Appendix. South Korea exogenous variables

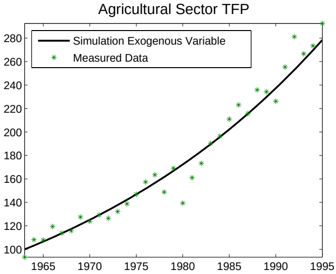
	Description	Sample period growth	Future growth	Data source
ν	Population growth	Smoothed data (0.025, 0.005)	0.005	Bank of Korea
γ_q	Rel agr price growth	$\frac{P_a Y_a / Y_a}{P_n Y_n / Y_n}$ smoothed (-0.012, 0.023)	-0.0216	Bank of Korea
γ_a	Agr TFP growth	0.032	0.032	To match n_a
γ_n	Nonagr TFP growth	0.021	0.021	To match n_a

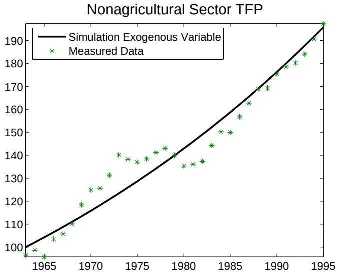
	Description	Value	Data source
$\mathbf{K}(0)$	Initial capital stock	$\frac{K}{Y_n}$=2.87 in 1963	Korea Development Institute

Appendix. South Korea exogenous variables

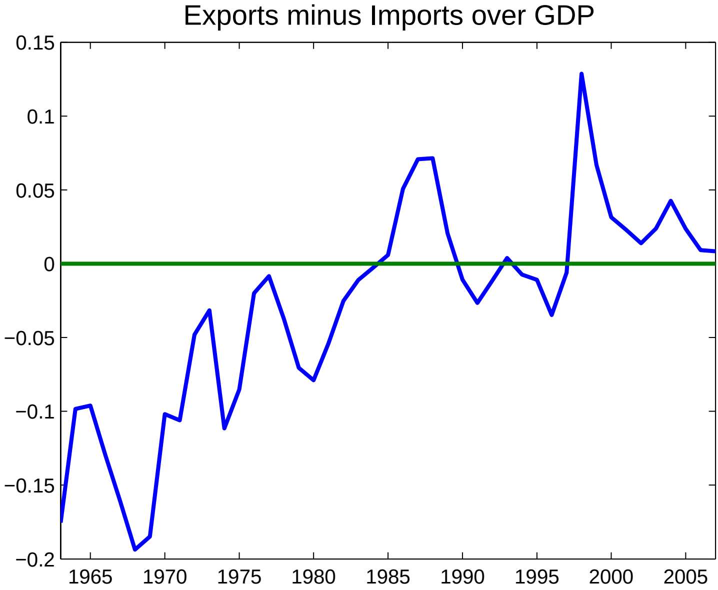








Appendix. South Korea Data



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Appendix. South Korea Policy experiments results

- Sample period results (1963-2007):

% Avg. change (w.r.t. Baseline)	q	n_a	c_n	c_a	k
Autarky	16.5	21	0.3	-1.1	-3.5
No subsidy	0	-17	0.65	0.04	2.8
No subs No tariff	-42	-73	10.9	5.5	12.1

- Real income growth:

Autarky	**Baseline**	**No subsidy**	**No ag policy**
4.5%	4.71%	4.72%	5.47%

- Intertemporal Welfare gain with respect to Autarky: (in terms of annual consumption expenditures)

Autarky	**Baseline**	**No subsidy**	**No ag policy**
0	0.4%	0.45%	5.4%

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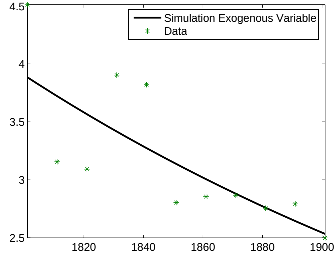
Appendix. United Kingdom Exogenous Variables

	Description	Sample period growth	Future growth	Data source
ν	Population growth	Smoothed data (0.016, 0.08)	0.01	Mitchell (1962) Maddison (2003)
γ_q	Rel agr price growth	Smoothed data (-0.0043)	-0.0043	Mitchell (1962) Deane,Cole (1969)
γ_a	Agr TFP growth	0.0125	0.0125	To match n_a
γ_n	Nonagr TFP growth	0.0065	0.0065	To match n_a

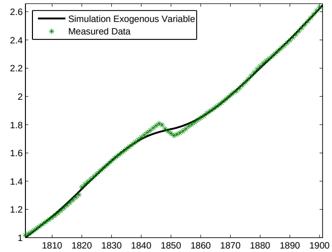
	Description	Value	Data source
$\mathbf{K}(0)$	Initial capital stock	$\frac{K}{Y_n} = 2.52$ in 1800	Feinstein (1988)

Appendix. United Kingdom Exogenous Variables

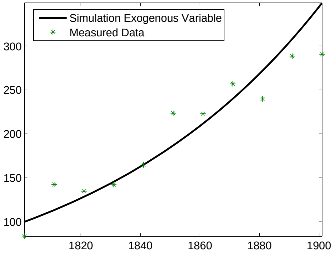
Agricultural relative price



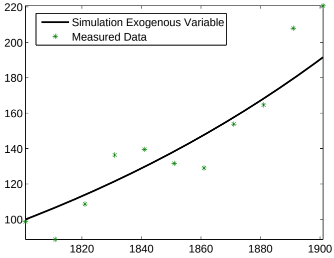
Total Population



Agricultural Sector TFP



Nonagricultural Sector TFP



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Appendix. United Kingdom Policy experiment results

- Sample period results (1800-1900):

% Avg. change (w.r.t. baseline)	q	n_a	c_n	c_a	k
Autarky	45.8	155.7	-10.5	-5.4	-20.8

- Real Income Growth:

Autarky	**Baseline**
1.28%	1.44%

- Intertemporal Welfare gain with respect to Autarky: (in terms of consumption expenditures)

Autarky	**Baseline**
0	5.5%

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Appendix. Alternative preferences simulations

- Household preferences:

$$\int_0^\infty e^{-\rho t} N(t)\, u(c_a(t), c_n(t))\, dt$$

$$u(c_a, c_n) = \mu^\sigma \frac{(c_a - \underline{c_a})^{1-\sigma}}{1-\sigma} + \log(c_n)$$

- Simulation parameter values:

	Description	Value	Source
μ	Agr good weight	47	to match c_a data
σ	Agr subsistence level	7.75	to match c_a data
$\underline{c_a}$	Agr cons threshold	35% agr cons 1963	to match c_a data

- Sample period results (1963-2007): comparison S. Korea simulations

	Growth %	q %	s_e %	c_n %	c_a %
Autarky	6.4	19.8	22.1	-0.1	-1.7
No subsidy	5.8	0	-21	0.1	0.09
No subs No tariff	5.5	-44	-76	13.18	7.45

Appendix. Alternative preferences simulations