Consumption-led Growth

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Motivation

1. What is the relationship between openness and growth?
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   (ii) What is special about Chinese-style (export-led) growth?

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- A model of endogenous convergence growth
  — to open the blackbox of productivity evolution under different economy openness regimes
  — a neoclassical (DRS) environment with endogenous innovation decisions by entrepreneurs
  — emphasis on the feedback from international borrowing into the pace and composition (T vs NT) of converegence

Empirical Motivation

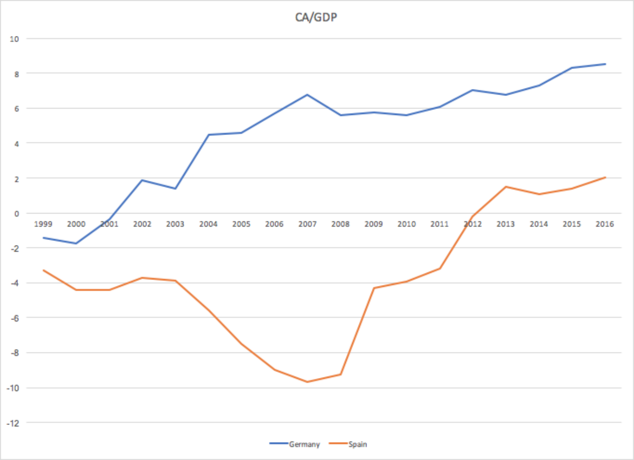
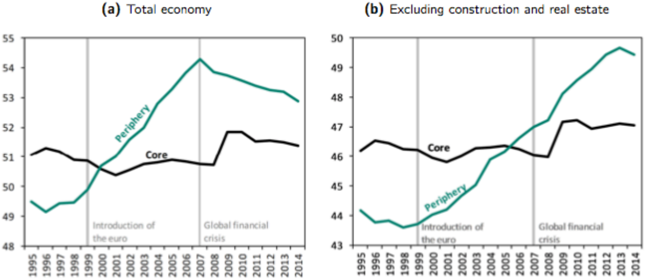


Figure: CA imbalances in the Euro Zone

Empirical Motivation

Figure 1 – Share of the non-tradable sector in total hours worked, by country group, 1995-2014, in %



Source: author's calculations using Eurostat and BACI.
Note: a threshold of 10% is used for the measure of tradability. Averages over countries weighted by the number of hours worked. The periphery includes the four countries of the EA12 (countries which adopted the euro in 2001 and before) with the lowest GDP per capita (at purchasing power standards) in 1995. The rest of the EA12 are considered as core countries. The periphery includes: EL; ES; IE; PT. The core countries are: AT; BE; DE; FI; FR; IT; LU; NL.

Main Insights

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  - (i) change in the relative size of the market
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  — a reduced-form relationship between NX and sectoral growth
  — furthermore, NX/Y is a sufficient statistic

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  — due to structural productivity imbalance, without sticky wages
  — wage flexibility essential for a sharp productivity rebound

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- Sudden stops in financial flows are followed by both recessions and fast tradable productivity growth take off
  — due to structural productivity imbalance, without sticky wages
  — wage flexibility essential for a sharp productivity rebound
- Laissez-faire productivity growth is in general suboptimal
  — capital controls may improve upon market allocation

Literature

- Learning-by-doing and dutch disease
  - Corden and Neary (1982), Krugman (1987), Young (1991)...
  - Export-led growth: Rajan and Subramanian (2005)

- Trade and growth:
  - Ventura (1997), Acemoglu and Ventura (2002)
  - Technology transfer: Parente and Prescott (2002)
  - Empirics: Frankel and Romer (1999)

- Transition growth after financial liberalization
  - Aioke, Benigno and Kiyotaki (2009)

- Growth and trade with Frechet distribution:
  - Kortum (1997), EK (2001, 2002), Klette and Kortum (2004)

MODEL SETUP

Model Setup

- Real small open economy in continuous time
  — exogenous world interest rate r^* in terms of world good
- Two sectors:
  — tradable (exportable) and non-tradable (non-exportable)
- Rest of the world (ROW) in steady state:

$$W^* = A_T^* = A_N^* = A^* \quad \text{and} \quad P_F^* = P_N^* = P^* = 1$$

- We study convergence growth trajectories starting from

$$A_T(0), A_N(0) < A^*$$

Households

- Representative household:

$$\max_{\{C(t),L(t)\}} \int_0^\infty e^{-\vartheta t} U(t) \mathrm{d}t, \quad U = \tfrac{1}{1-\sigma} C^{1-\sigma} - \tfrac{1}{1+\varphi} L^{1+\varphi}$$

$$\text{s.t.} \qquad \dot{B} = r^* B + NX, \quad NX = WL + \Pi - PC$$

- Results in labor supply:

$$C_t^\sigma L_t^\varphi = \frac{W_t}{P_t} \equiv w_t$$

- Aggregate GDP and absorbtion:

$$GDP = WL + \Pi \quad \text{and} \quad Y = PC \quad \Rightarrow \quad GDP = Y + NX$$

- Special cases: $\sigma \to 1$ and $\varphi \to \infty$ ($L = \bar{L}$)

Demand

- Two sectors:

$$Y = PC = \gamma P_T C_T + (1-\gamma) P_N C_N$$

where

$$C = C_T^{\gamma} C_N^{1-\gamma} \quad \text{and} \quad C_T = \left[\kappa^{\frac{1}{\rho}} C_F^{\frac{\rho-1}{\rho}} + (1-\kappa)^{\frac{1}{\rho}} C_H^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}, \ \rho > 1$$

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- Aggregators of individual varieties:

$$C_H = \left[\frac{1}{\gamma} \int_0^{\Lambda_T} C_H(i)^{\frac{\rho-1}{\rho}} \mathrm{d}i \right]^{\frac{\rho}{\rho-1}} \quad \text{and} \quad C_N = \left[\frac{1}{1-\gamma} \int_0^{\Lambda_N} C_N(i)^{\frac{\rho-1}{\rho}} \mathrm{d}i \right]^{\frac{\rho}{\rho-1}}$$

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- Demand:

$$C_H(i) = (1-\kappa) \left(\frac{P_H(i)}{P_T} \right)^{-\rho} \frac{Y}{P_T} \quad \text{and} \quad C_N(i) = \left(\frac{P_N(i)}{P_N} \right)^{-\rho} \frac{Y}{P_N}$$

▸ Price indexes

Exports and Imports

- Tradable expenditure:

$$\gamma P_T C_T = \gamma P_F C_F + \int_0^{\Lambda_T} P_H(i) C_H(i) \mathrm{d}i$$

- Aggregate imports:

$$X^* = \gamma P_F C_F = \gamma \kappa \left(\frac{P_F}{P_T} \right)^{1-\rho} Y, \quad P_F = \tau P_F^* = \tau$$

- Aggregate exports:

$$X = \gamma P_H^* C_H^* = \gamma \kappa (\tau P_H)^{1-\rho} Y^*$$

- Net exports:

$$NX = X - X^* = \gamma \kappa \tau^{1-\rho} \left[P_H^{1-\rho} Y^* - P_T^{\rho-1} Y \right]$$

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Technology and Revenues

- Technology:

$$Y_J(i) = A_J(i)L_J(i), \quad i \in [0, \Lambda_J],\ J \in \{T, N\}$$

- Marginal cost pricing if technology is rival (same in $J = N$):

$$P_H(i) = \frac{W}{A_T(i)} \ \Rightarrow \ P_H = \frac{W}{A_T},\ A_T = \left[\frac{1}{\gamma}\int_0^{\Lambda_T} A_T(i)^{\rho-1}\mathrm{d}i\right]^{\frac{1}{\rho-1}}$$

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- Revenues:

$$R_N(i) = P_N(i)C_N(i) = \left(\frac{P_N(i)}{P_N}\right)^{1-\rho} R_N,$$

$$R_T(i) = P_H(i)C_H(i) + P_H^*(i)C_H^*(i) = \left(\frac{P_H(i)}{P_H}\right)^{1-\rho} R_T$$

where

$$R_N = Y \quad \text{and} \quad R_T = (1-\kappa)\left(\frac{P_H}{P_T}\right)^{1-\rho} Y + \kappa(\tau P_H)^{1-\rho} Y^*$$

Technology Draws

- An entrepreneur has $n \gg 1$ possible ideas (projects):

$$Z_{J(\ell)}(\ell) \stackrel{iid}{\sim} Frechet(z, \theta), \quad \ell = 1..n, \quad \theta > \rho - 1$$

- A fraction γ of ideas are tradable, $J(\ell) = T$

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- Project choice:

$$\hat{\ell} = \arg\max_{\ell=1..n} \Pi_{J(\ell)}(\ell)$$

and we define $(\hat{Z}_T, \hat{Z}_N, \hat{Z})$ and $(\hat{\Pi}_T, \hat{\Pi}_N, \hat{\Pi})$

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- **Lemma 1** (i) *The probability to adopt a tradable project:*

$$\pi_T \equiv \mathbb{P}\{\hat{\Pi}_T \geq \hat{\Pi}_N\} = \frac{\gamma \cdot \chi^{\frac{\theta}{\rho-1}}}{\gamma \cdot \chi^{\frac{\theta}{\rho-1}} + 1 - \gamma}, \quad \chi \equiv \left(\frac{P_H}{P_N}\right)^{\rho-1} \frac{R_T}{R_N}.$$

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(ii) *The productivity conditional on adoption:*

$$\mathbb{E}\left\{\hat{Z}_T^{\rho-1} \,\middle|\, \hat{\Pi}_T \geq \hat{\Pi}_N\right\} = \left(\frac{\pi_T}{\gamma}\right)^{\nu-1} A^{*\rho-1},$$

where $A^* \equiv \mathbb{E}\hat{Z} = (nz)^{1/\theta}\Gamma(\nu)^{\frac{1}{\rho-1}}$ *and* $\nu \equiv 1 - \frac{\rho-1}{\theta} \in (0,1)$.

Productivity Dynamics

- λ is the innovation rate and δ is the rate at which technologies become obsolete:

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- **Lemma 2** *The sectoral productivity dynamics is given by:*

$$\frac{\dot{A}_T}{A_T} = \frac{\delta}{\rho - 1}\left[\left(\frac{\bar{A}}{A_T}\right)^{\rho-1}\left(\frac{\pi_T}{\gamma}\right)^{\nu} - 1\right] \text{ where } \bar{A} \equiv A^* \left(\frac{\lambda}{\delta}\right)^{\frac{1}{\rho-1}}.$$

CLOSED ECONOMY

Closed Economy, $\kappa \equiv 0$

- In closed economy $R_T = R_N = Y$, and therefore:

$$\chi = \left(\frac{P_H}{P_N}\right)^{\rho-1} = \left(\frac{A_N}{A_T}\right)^{\rho-1}$$

- The project choice is, thus:

$$\frac{\pi_T(t)}{1-\pi_T(t)} = \frac{\gamma}{1-\gamma}\left(\frac{A_N(t)}{A_T(t)}\right)^{\theta}$$

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(ii) *Equilibrium allocation $C = w^{\frac{1+\varphi}{\sigma+\varphi}}$, $L = w^{\frac{1-\sigma}{\sigma+\varphi}}$, $w = A$.*

(iii) *Efficiency: ...*

OPEN ECONOMY I
BALANCED TRADE

Balanced Trade

- Consider open economy with $\kappa > 0$ and $\tau \geq 1$
- **Lemma 3** (i) *The relative revenue shifter is given by:*

$$\frac{R_T}{R_N} = (1-\kappa)\left(\frac{P_H}{P_T}\right)^{1-\rho} + \kappa(\tau P_H)^{1-\rho}\frac{Y^*}{Y} = 1 + \frac{NX}{\gamma Y}.$$

(ii) *Under balanced trade,* $\chi = (A_N/A_T)^{\rho-1}$*, and hence* $\pi_T(t)$ *and* $(A_T(t), A_N(t))$ *follow the same path as in autarky.*

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- Equilibrium allocation is nonetheless different from autarkic. For $\sigma = 1$:

$$w = C = A \cdot \left(\frac{1}{\tau^{2\rho-1}}\frac{A^*}{A_T}\right)^{\frac{\kappa\gamma}{1+(2-\kappa)(\rho-1)}}$$

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- Laisser-faire productivity dynamics is suboptimal. The planner would choose $\pi_T(t) < \gamma$ for all $t \geq 0$.

OPEN ECONOMY II
FINANCIAL OPENNESS

Financial Openness

- With open current account:

$$\frac{\pi_T}{1-\pi_T} = \frac{\gamma}{1-\gamma}\chi^{\frac{\theta}{\rho-1}} = \left(\frac{A_N}{A_T}\right)^{\theta}\left[1+\frac{NX}{\gamma Y}\right]^{\frac{\theta}{\rho-1}}$$

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- **Lemma 4** $NX(t) < 0$ *and* $A_T(t) \geq A_N(t) \;\Rightarrow\; \dot{A}_T(t) < \dot{A}_N(t)$.

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- **Proposition 5** *In st.st. with $\overline{NX}=-r^*\bar{B}>0$: $\bar{A}_T>\bar{A}>\bar{A}_N$.*
- **Proposition 6** *Starting from $A_T(0)=A_N(0)<\bar{A}$, there exist two cutoffs $0<t_1<t_2<\infty$:*
    - *$NX(t)<0$ for $t\in[0,t_1)$ and $NX(t)>0$ for $t>t_1$, and*
    - *$A_T(t)<A_N(t)$ for $t\in(0,t_2)$ and $A_T(t)>A_N(t)$ for $t>t_2$.*

  At $t=t_2$, $A_T(t)=A_N(t)=A(t)<A^a(t)$.

Convergence Path

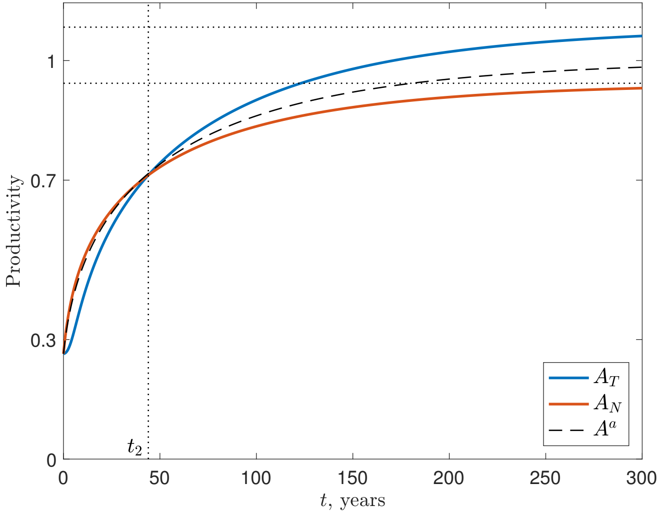
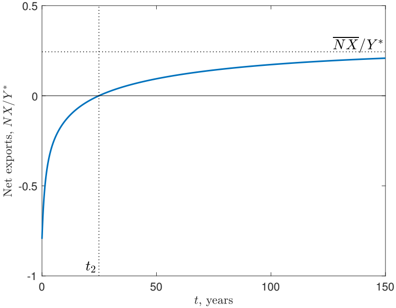
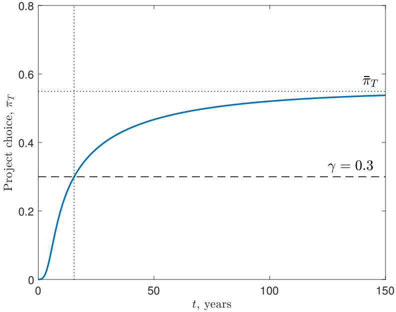


Figure: Productivity convergence in closed and open economies

Impact of Openness





- Two effects of openness:
  1. Relative size of the market: Y/Y^*
  2. Competition: $P_T/P_H < 1$

$$1 + \frac{NX}{\gamma Y} = \left(\frac{P_H}{P_T}\right)^{1-\rho} \cdot \left[(1-\kappa) + \kappa \left(\frac{\tau}{P_H}\right)^{1-\rho} \overbrace{\frac{P_H^{1-\rho} Y^*}{P_T^{\rho-1} Y}}^{=X/X^*}\right]$$

Endogenous Innovation Rate

- Endogenous participation of entrepreneurs if $\mathbb{E}\hat{\Pi} \geq \phi W$:

$$\lambda = \Phi\left(\frac{\mathbb{E}\hat{\Pi}}{W}\right) \quad \text{and} \quad \frac{\mathbb{E}\hat{\Pi}}{W} = \frac{\varrho R_N / W}{A_N^{\rho-1}} \mathbb{E} \max\left\{\chi \hat{Z}_T^{\rho-1}, \hat{Z}_N^{\rho-1}\right\}$$

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- **Lemma 5** $$\frac{\mathbb{E}\hat{\Pi}}{W} = \varrho\left(\frac{A^*}{A}\cdot\frac{A}{\hat{A}_\theta}\right)^{\rho-1}\left[\frac{\gamma\chi^{\frac{\theta}{\rho-1}} + 1 - \gamma}{\gamma\left(\frac{A_N}{A_T}\right)^{\theta} + 1 - \gamma}\right]^{\frac{\rho-1}{\theta}}\frac{C}{w},$$

where $\chi = \left(\frac{A_N}{A_T}\right)^{\rho-1}\left[1 + \frac{NX}{\gamma Y}\right]$ *and* $\frac{C}{w} = w^{\frac{1-\sigma}{\sigma+\varphi}}\left[1 + \frac{NX}{Y}\right]^{\frac{-\varphi}{\sigma+\varphi}}$.

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- **Proposition 8** (i) λ *is increasing in* A^*/A *and in* $A/\hat{A}_\theta \geq 1$.
(ii) λ *increases with trade openness iff* $\sigma < 1$ *and* $\varphi < \infty$.
(iii) *When* $\sigma = 1$, λ *increases with* NX *when* $A_N \geq A_T$.

Empirical Implications

- Reduced-form relationship between NX and sectoral growth:

$$\frac{\dot{A}_T(t)}{A_T(t)} - \frac{\dot{A}_N(t)}{A_N(t)} = g_0\left[-(\rho-1)\log\frac{A_T(t)}{A_N(t)} + \frac{\nu\big(\pi_T(t)-\gamma\big)}{\gamma(1-\gamma)}\right]$$
$$= g_0\left[-(\rho-1)\,(1+\mu)\log\frac{A_T(t)}{A_N(t)} + \frac{\mu}{\gamma}\frac{NX(t)}{Y(0)}\right],$$

  with $g_0 \equiv \frac{\delta}{\rho-1}\left(\frac{\lambda}{\delta}\frac{A^*}{A_0}\right)^{\rho-1}$, which is also the base growth rate

  — holds whether $NX \neq 0$ are market outcomes or policy-induced

  — i.e., applies equally for $NX < 0$ in Spain and $NX > 0$ in China

- NX/Y is a sufficient statistic for the feedback effect from equilibrium allocation to sectoral productivity growth

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- NX/Y is a sufficient statistic for the feedback effect from equilibrium allocation to sectoral productivity growth

- Preliminary evidence of this effect in the KLEMS data

  — CA/Y interacted with sector i tradability predicts sector i productivity growth rate in the panel of country-sectors

Unit Labor Costs

- Two ULC measures: w/A and W/A_T
  - move together holding τ constant

- Autarky (assume $\sigma = 1$):

$$w^a(t) = C^a(t) = A(t)$$

- Balanced trade:

$$w^b(t) = C^b(t) = A(t) \left(\frac{A^*}{A_T(t)} \right)^{\frac{\kappa\gamma}{1+(2-\kappa)(\rho-1)}} > A(t)$$

- Open financial account:

$$w^b(0) < w(0) < C(0)$$

- ULC increase on impact and gradually fall along the convergence path

APPLICATIONS

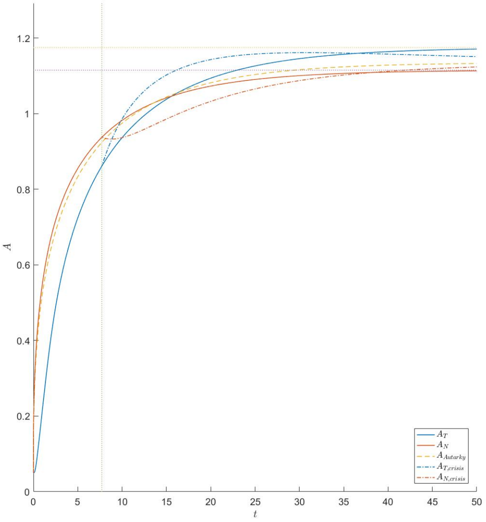
Application

1. Rollover crisis
   - Sudden stop in capital flows during transition triggers a reversal in trade deficits and a recession in non-tradable sector
   - Rapid take off in tradable productivity growth, provided labor market can flexibly adjust by a sharp decline in wages

2. Misallocation and growth policy

3. Physical capital and financial frictions

Rollover Crisis



CONCLUSION

APPENDIX

Price Indexes

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- Average sectoral prices:

$$P_H = \left[\frac{1}{\gamma}\int_0^{\Lambda_T} P_H(i)^{1-\rho}\mathrm{d}i\right]^{\frac{1}{1-\rho}} \text{ and } P_N = \left[\frac{1}{1-\gamma}\int_0^{\Lambda_N} P_N(i)^{1-\rho}\mathrm{d}i\right]^{\frac{1}{1-\rho}}$$

- Aggregate price indexes:

$$P = P_T^{\gamma}P_N^{1-\gamma} \text{ where } P_T = \left[\kappa P_F^{1-\rho} + (1-\kappa)P_H^{1-\rho}\right]^{\frac{1}{1-\rho}}$$

- Equilibrium sectoral prices:

$$P_H = \frac{W}{A_T}, \quad P_N = \frac{W}{A_N} \text{ and } P_F = \tau$$

- Real wage rate:

$$w = \frac{W}{P} = A\left[1-\kappa+\kappa\left(\frac{W}{\tau A_T}\right)^{\rho-1}\right]^{\frac{\gamma}{\rho-1}}, \quad A \equiv A_T^{\gamma}A_N^{1-\gamma}$$

Solution for NX

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- Equilibrium system:

$$C = w^{\frac{1+\varphi}{\sigma+\varphi}} \left[1 + \frac{NX}{Y}\right]^{-\frac{\varphi}{\sigma+\varphi}} \quad \text{where} \quad w = A \left(\frac{W}{\tau A_T}\right)^{\kappa\gamma}$$

and

$$\frac{NX}{Y} = \frac{\gamma\kappa}{\left(\frac{W}{\tau A_T}\right)^{\rho-\kappa\gamma}} \left[\tau^{1-2\rho} \frac{A^{*\frac{1+\varphi}{\sigma+\varphi}}}{C} \frac{A}{A_T} - \left(\frac{W}{\tau A_T}\right)^{(1-\kappa\gamma)+(2-\kappa)(\rho-1)}\right]$$