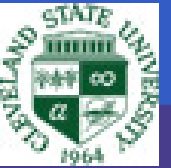


Engines of Liberation: The Impact of Technological Progress in an Imperfect Competition Setting

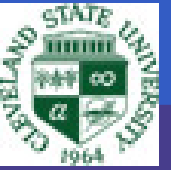
Sebastien Buttet

Cleveland State University



Two Long-Run Facts

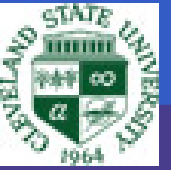
Between 1950 and 2000:



Two Long-Run Facts

Between 1950 and 2000:

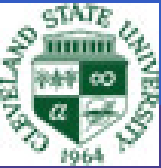
- Real price of home appliances decreased 10-fold.



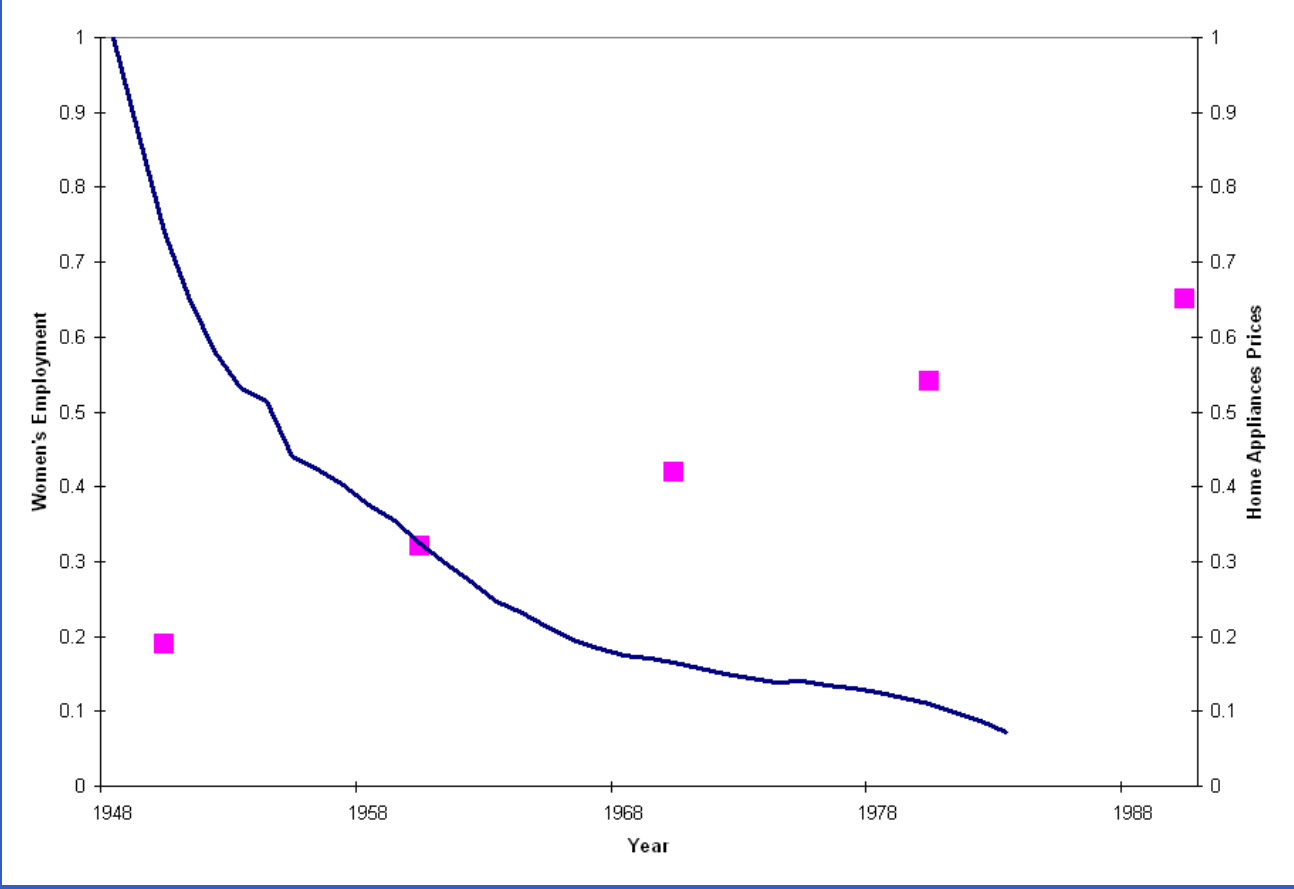
Two Long-Run Facts

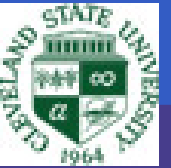
Between 1950 and 2000:

- Real price of home appliances decreased 10-fold.
- Participation rates of married women increased 12-fold from 20% to 66%.



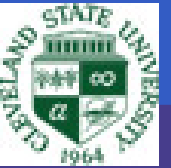
Employment - Appliances Price





Industry Dynamics

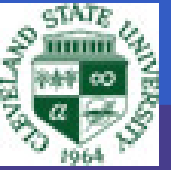
Consolidation after 1960:



Industry Dynamics

Consolidation after 1960:

- Average number of firms in the industry declines.

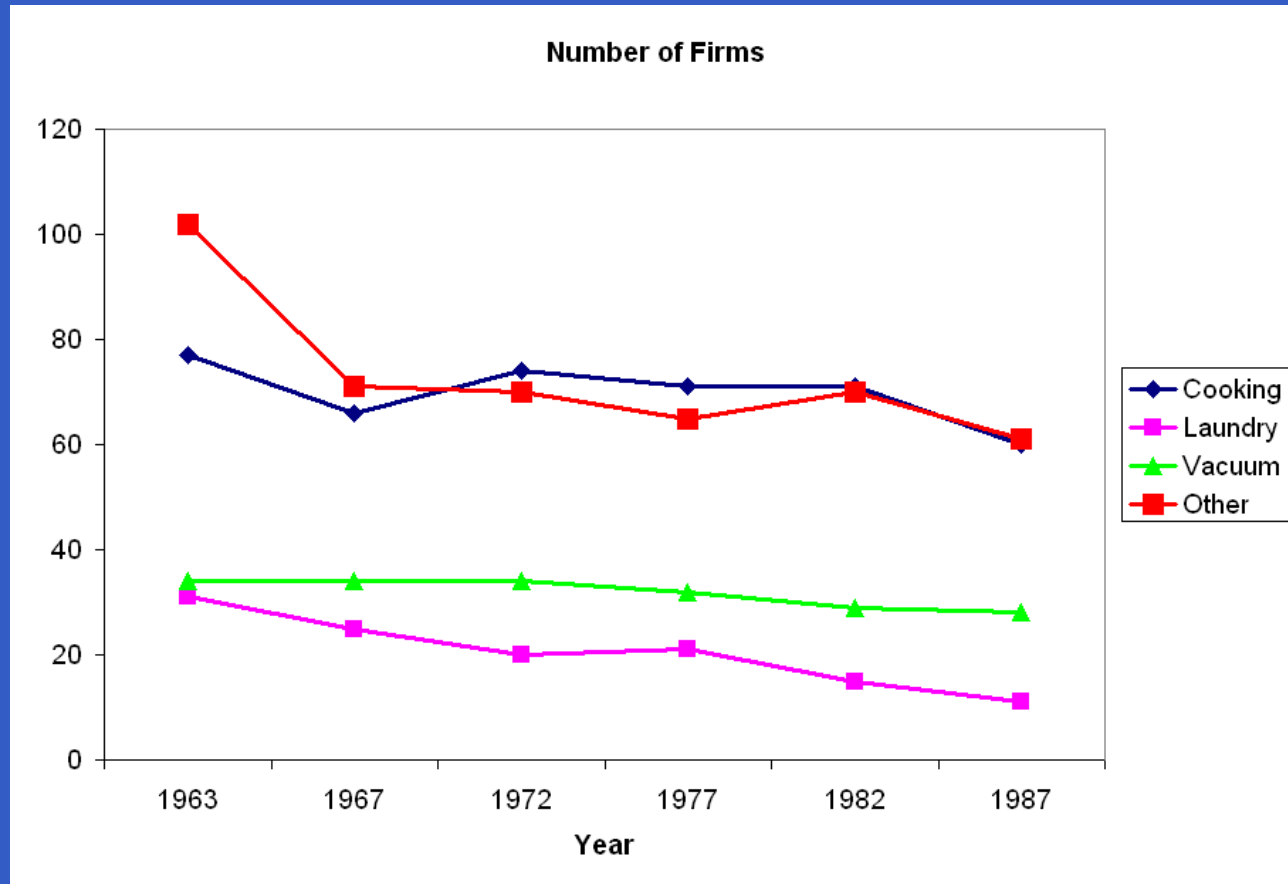


Industry Dynamics

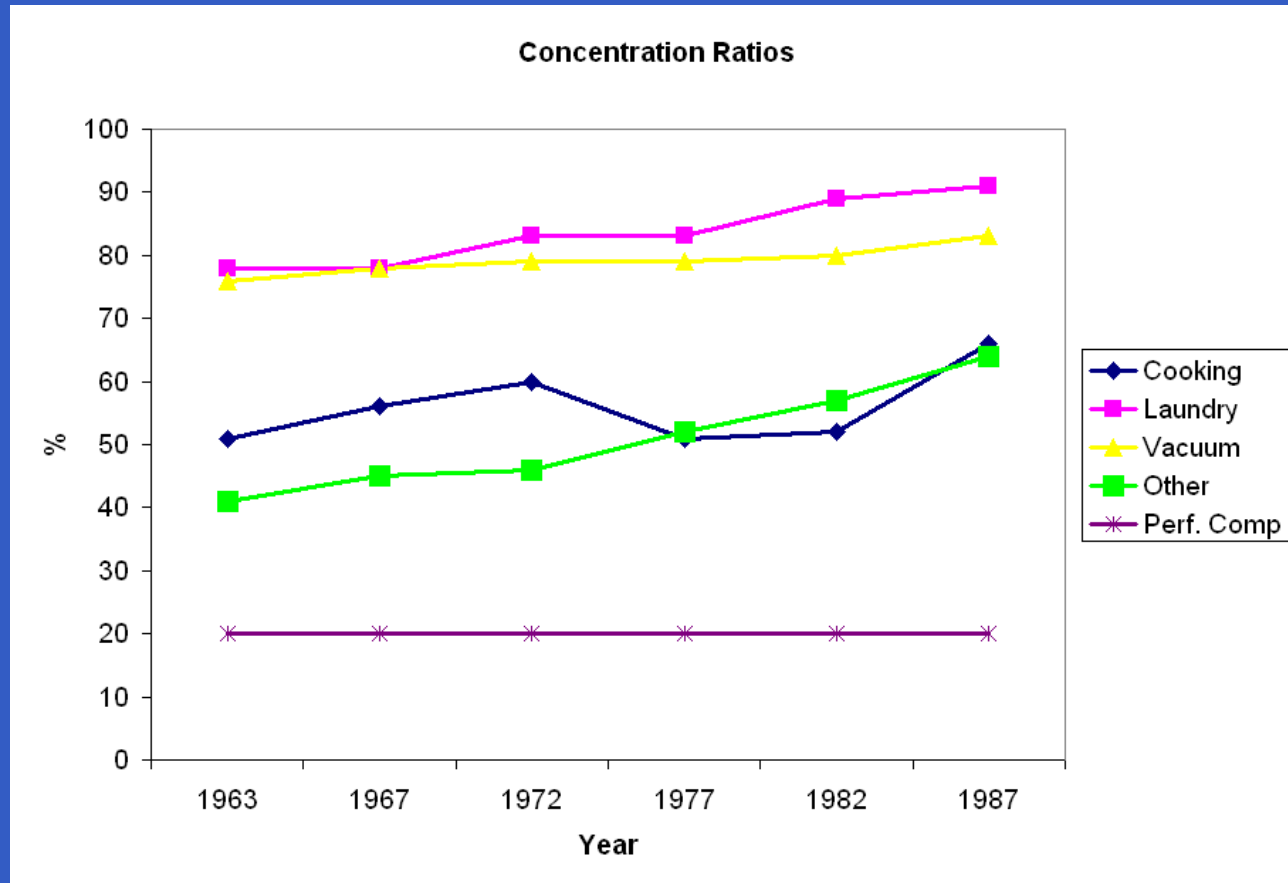
Consolidation after 1960:

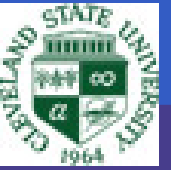
- Average number of firms in the industry declines.
- Concentration ratios increase by 20 perc. points

Number of Firms



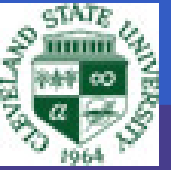
Concentration Ratios





Question

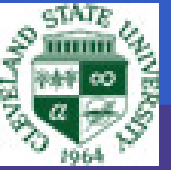
How much of changes in:



Question

How much of changes in:

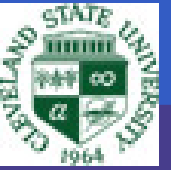
- price of home appliances



Question

How much of changes in:

- price of home appliances
- employment of married women

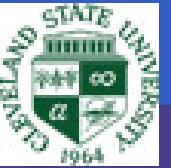


Question

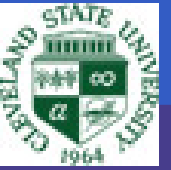
How much of changes in:

- price of home appliances
- employment of married women

can be accounted for by changes in market structure in the home appliances sector?

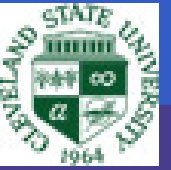


Mechanism



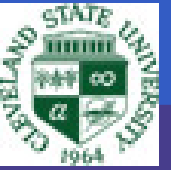
Mechanism

- Decline in the demand for Home Appliances as the fraction of HH that own appliances increases
⇒ Consolidation



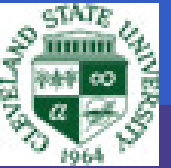
Mechanism

- Decline in the demand for Home Appliances as the fraction of HH that own appliances increases
⇒ Consolidation
- Price of Home Appliances:
Increased Market Power (+)
Economies of Scale (-)



Literature Review

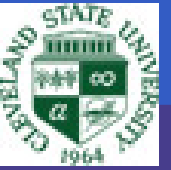
Greenwood, Seshadri, and Yorokoglu (2005)



Literature Review

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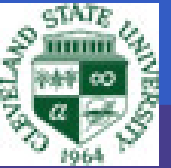
- Decline in Price of Home Appliances accounts for more than 1/2 of the increase in women's participation



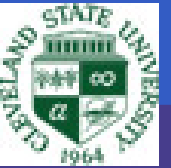
Literature Review

Greenwood, Seshadri, and Yorokoglu (2005)

- Decline in Price of Home Appliances accounts for more than 1/2 of the increase in women's participation
- Decline in Price of Home Appliances comes from higher TFP in appliances sector

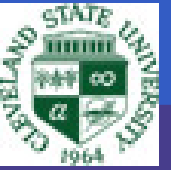


Model



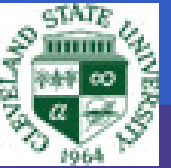
Model

- 3 sectors: household, market good, home appliances



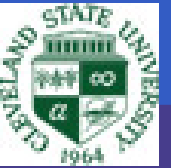
Model

- 3 sectors: household, market good, home appliances
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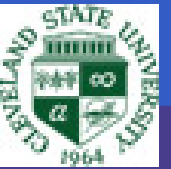


Model

- 3 sectors: household, market good, home appliances
- Imperfect competition in home appliances sector
- TFP grows at the same rate in market good and home appliances sector



Household

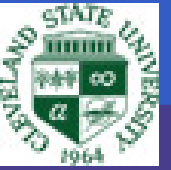


Household

- Preferences:

$$U(c_{mt}, c_{ht}, l_t) =$$

$$\sum_t \delta^{t-1} (\alpha \ln(c_{mt}) + \beta \ln(c_{ht}) + (1 - \alpha - \beta) \ln(l_t))$$



Household

- Preferences:

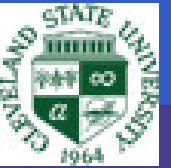
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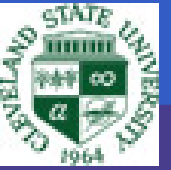
- Choice Set:

Buy Appliances, $a_t \in \{0, 1\}$

Women's Employment, $e_t \in \{0, 1\}$



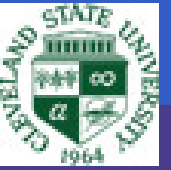
Household



Household

- Budget Constraint:

$$c_{mt} + p_t a_t = w_t (\lambda_m + \lambda_f e_t)$$



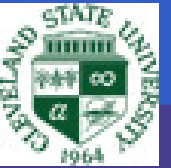
Household

- Budget Constraint:

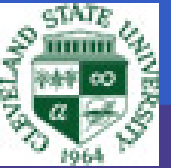
$$c_{mt} + p_t a_t = w_t (\lambda_m + \lambda_f e_t)$$

- Time Constraint:

$$l_t + t_w (1 + e_t) + \eta (1 + (\rho - 1)(1 - a_t)) = 2$$



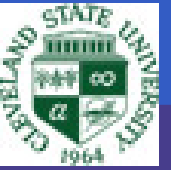
Home Production



Home Production

Home Technology Set:

$$c_{ht} \leq \min\{d_t, \zeta n_t\}$$

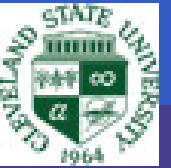


Home Production

Home Technology Set:

$$c_{ht} \leq \min\{d_t, \zeta n_t\}$$

- Low ζ : Labor-intensive Technology that can be operated at no cost

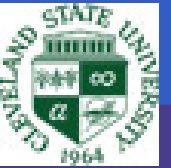


Home Production

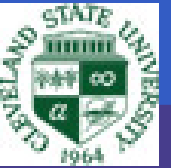
Home Technology Set:

$$c_{ht} \leq \min\{d_t, \zeta n_t\}$$

- Low ζ : Labor-intensive Technology that can be operated at no cost
- $\zeta' > \zeta$: Labor-saving Technology that can be operated at price p_t

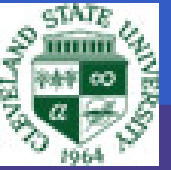


Market Sector



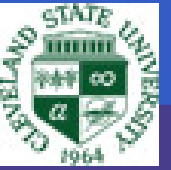
Market Sector

- Perfectly Competitive Markets



Market Sector

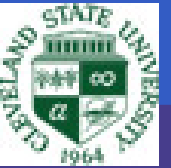
- Perfectly Competitive Markets
- Firms' Profit Function: $\Pi_{mt} = A_{mt}l_{mt} - w_t l_{mt}$



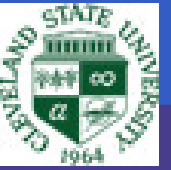
Market Sector

- Perfectly Competitive Markets
- Firms' Profit Function: $\Pi_{mt} = A_{mt}l_{mt} - w_t l_{mt}$
- Perfectly Elastic Labor Demand:

$$A_{mt} = w_t$$

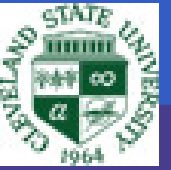


Appliances Sector



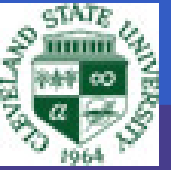
Appliances Sector

- Imperfect Competition - Oligopoly with Free Entry



Appliances Sector

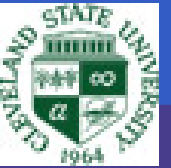
- Imperfect Competition - Oligopoly with Free Entry
- Increasing Returns to Scale Technology



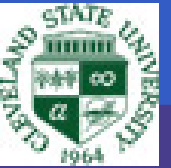
Appliances Sector

- Imperfect Competition - Oligopoly with Free Entry
- Increasing Returns to Scale Technology
- Firms' Profit Function:

$$\Pi_{at} = p_{at}(Y_{at})A_{at}l_{at}^{\theta} - w_t l_{at} \quad \text{with } \theta > 1$$

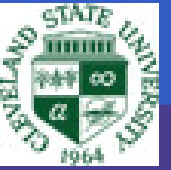


Assumptions



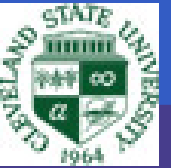
Assumptions

- Depreciation rate for home appliances is zero



Assumptions

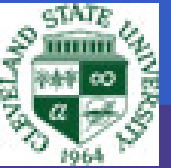
- Depreciation rate for home appliances is zero
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Assumptions

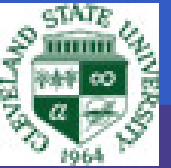
- Depreciation rate for home appliances is zero
- Distribution of men's earnings is lognormal
- Perfect assortative matching between husband and wife's earnings

$$w_f = \varphi w_m$$



Equilibrium - $(A_{mt}, A_{at}, f(\lambda_m))$

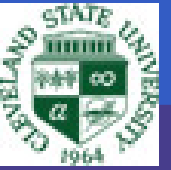
$$(n_t^*, l_{at}^*, w_t^*, p_t^*, Y_{at}^*, \mathcal{S}_f)$$



Equilibrium - $(A_{mt}, A_{at}, f(\lambda_m))$

$$(n_t^*, l_{at}^*, w_t^*, p_t^*, Y_{at}^*, \mathcal{S}_f)$$

- $w_t^* = A_{mt}$

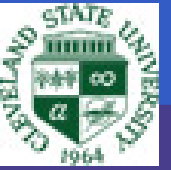


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- $(n_t^*, l_{at}^*) \rightarrow Y_{at}^* = n_t^* A_{at} l_{at}^{\theta}$



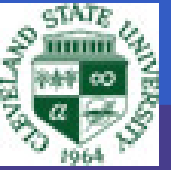
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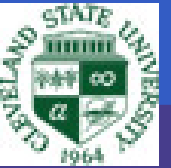
- $p_t^* \rightarrow \int_0^{+\infty} a\left(\frac{p_t^*}{w_t^*}, \lambda_m\right) f(\lambda_m) d\lambda_m = Y_{at}^*$



Equilibrium - $(A_{mt}, A_{at}, f(\lambda_m))$

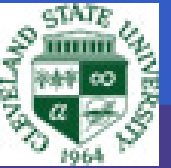
$$(n_t^*, l_{at}^*, w_t^*, p_t^*, Y_{at}^*, \mathcal{S}_f)$$

- $w_t^* = A_{mt}$
- $(n_t^*, l_{at}^*) \rightarrow Y_{at}^* = n_t^* A_{at} l_{at}^{\theta}$
- $p_t^* \rightarrow \int_0^{+\infty} a\left(\frac{p_t^*}{w_t^*}, \lambda_m\right) f(\lambda_m) d\lambda_m = Y_{at}^*$
- $\mathcal{S}_f\left(\frac{p_t^*}{w_t^*}\right)$



Model Properties

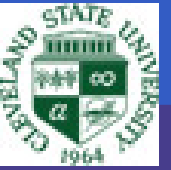
Proposition 1: Individual Decisions



Model Properties

Proposition 1: Individual Decisions

- when $s_t = 1$, $a\left(\frac{p_{at}}{\lambda_m w_t}\right) = 0$, $e\left(\frac{p_{at}}{\lambda_m w_t}\right) = 1$,

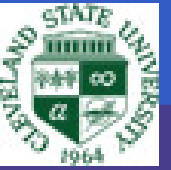


Model Properties

Proposition 1: Individual Decisions

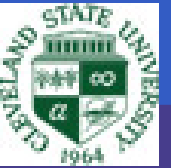
- when $s_t = 1$, $a\left(\frac{p_{at}}{\lambda_m w_t}\right) = 0$, $e\left(\frac{p_{at}}{\lambda_m w_t}\right) = 1$,
- when $s_t = 0$,

$$e\left(\frac{p_{at}}{\lambda_m w_t}\right) = a\left(\frac{p_{at}}{\lambda_m w_t}\right) = 1 \quad \Leftrightarrow \quad \lambda_m \geq \hat{\lambda}_m = \frac{p_{at}}{w_t \phi(\varphi)}$$



Model Properties

Proposition 2: Appliances Sector Output

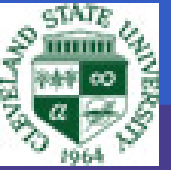


Model Properties

Proposition 2: Appliances Sector Output

There exists a technology threshold \bar{A}_a such that:

- $Y_{at} = 0$ when $0 < A_{at} < \bar{A}_a$,

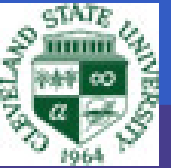


Model Properties

Proposition 2: Appliances Sector Output

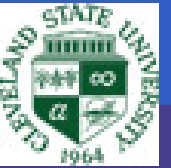
There exists a technology threshold \bar{A}_a such that:

- $Y_{at} = 0$ when $0 < A_{at} < \bar{A}_a$,
- $Y_{at} = F\left(\frac{p_{at-1}}{\phi(\varphi)w_{t-1}}\right) - F\left(\frac{p_{at}}{\phi(\varphi)w_t}\right)$ when $A_{at} \geq \bar{A}_a$,



Model Properties

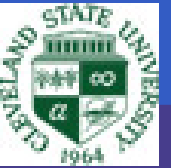
Proposition 3: Comparative Statics



Model Properties

Proposition 3: Comparative Statics

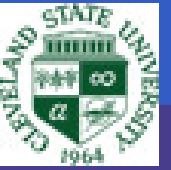
- $\frac{\partial Y_{at}}{\partial A_{at}} \geq 0$ $\frac{\partial Y_{at}}{\partial A_{mt}} = 0$



Model Properties

Proposition 3: Comparative Statics

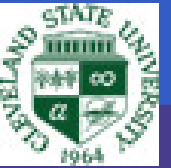
- $\frac{\partial Y_{at}}{\partial A_{at}} \geq 0$ $\frac{\partial Y_{at}}{\partial A_{mt}} = 0$
- $\frac{\partial p_{at}}{\partial A_{at}} \leq 0$ $\frac{\partial p_{at}}{\partial A_{mt}} = 0$



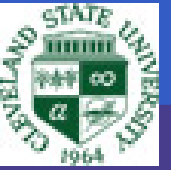
Model Properties

Proposition 3: Comparative Statics

- $\frac{\partial Y_{at}}{\partial A_{at}} \geq 0$ $\frac{\partial Y_{at}}{\partial A_{mt}} = 0$
- $\frac{\partial p_{at}}{\partial A_{at}} \leq 0$ $\frac{\partial p_{at}}{\partial A_{mt}} = 0$
- n_t first increases then decreases

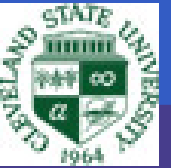


Calibration



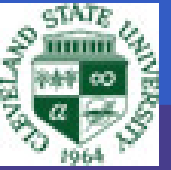
Calibration

- $\sigma = 0.9$ Knowles (1999),



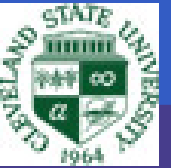
Calibration

- $\sigma = 0.9$ Knowles (1999),
- $z = 1.4\%$ Jones (2001),



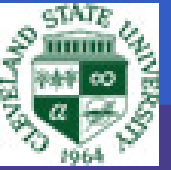
Calibration

- $\sigma = 0.9$ Knowles (1999),
- $z = 1.4\%$ Jones (2001),
- Calibrate θ_a such that 5 percent of married women work in 1900
 $\Rightarrow \theta_a = 1.32$

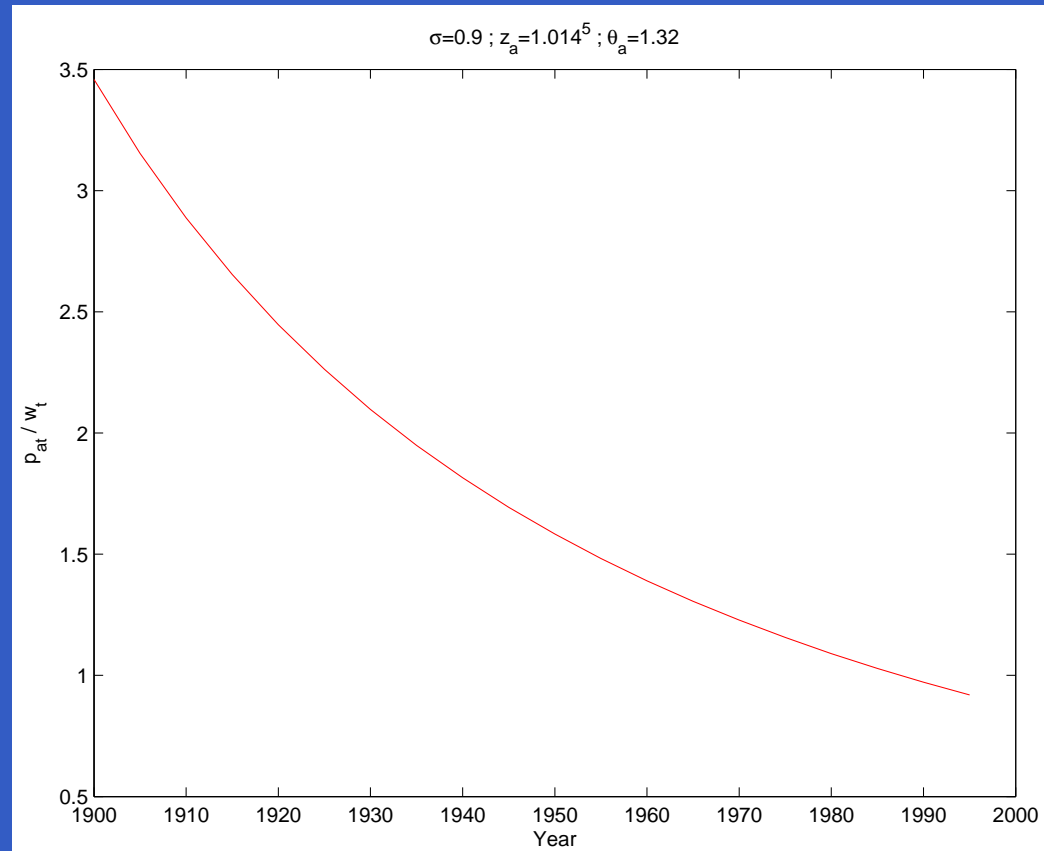


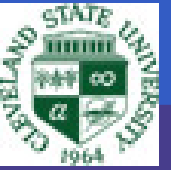
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- $\sigma = 0.9$ Knowles (1999),
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- Borrow parameters for the home good production function from Greenwood, Seshadri, and Yorokoglu (2005)

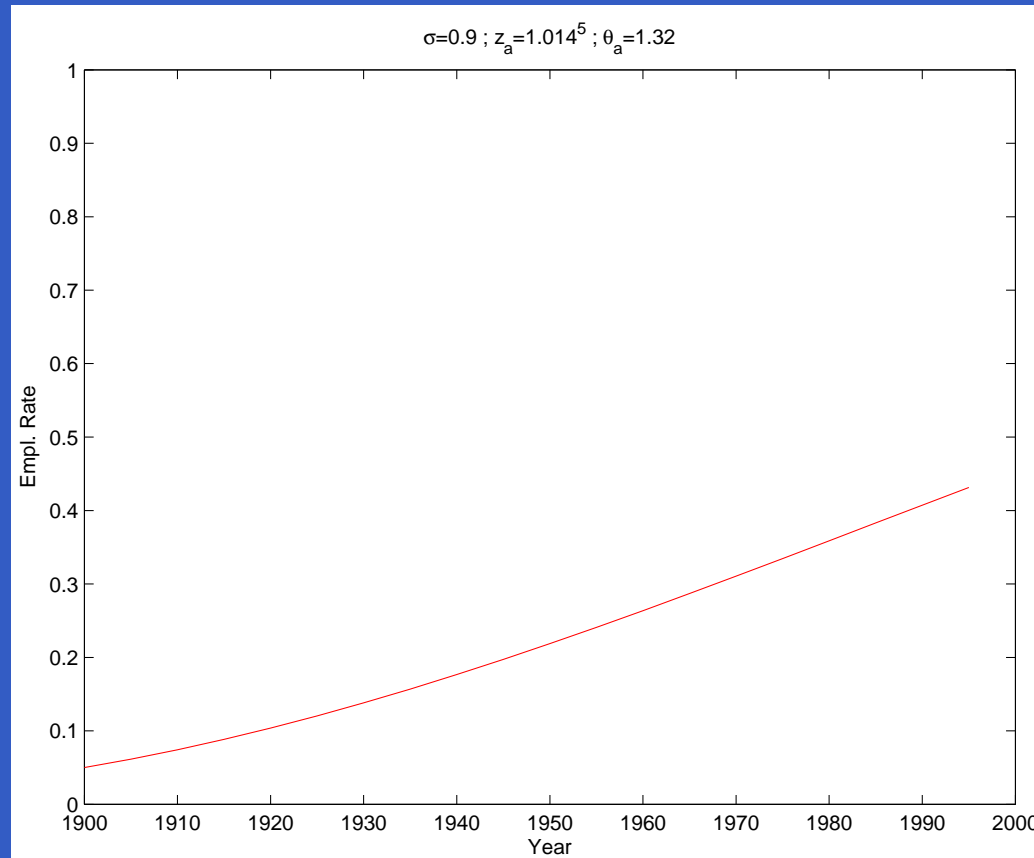


Home Appliances Price

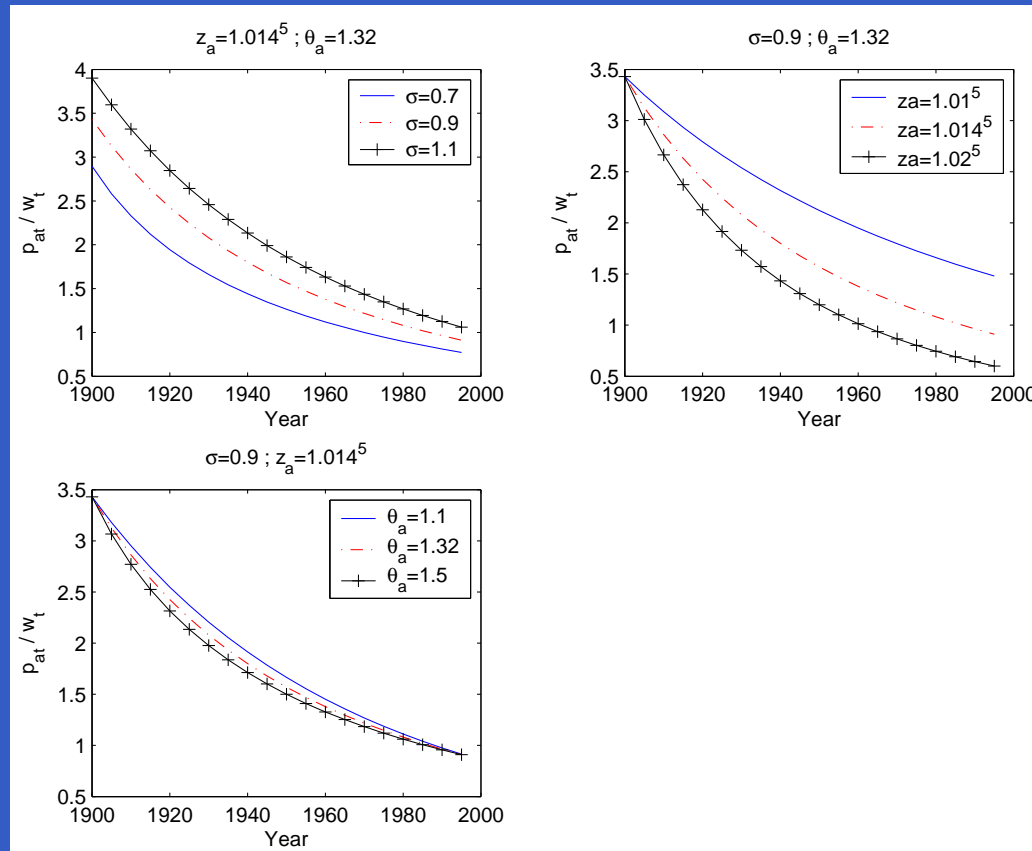




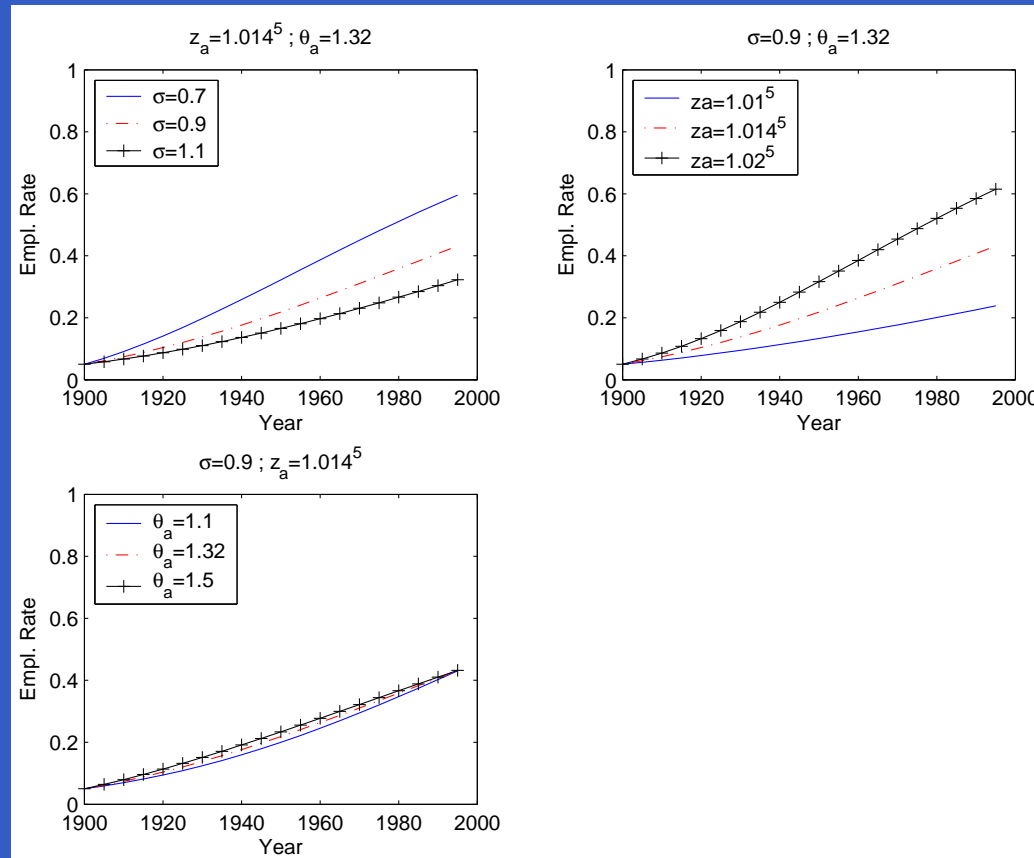
Employment of Married Women

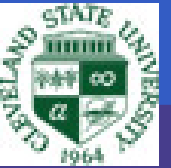


Comparative Statics 1

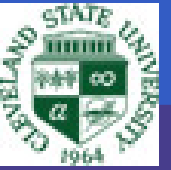


Comparative Statics 2



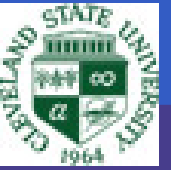


Conclusion



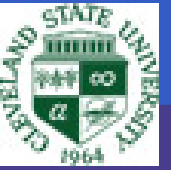
Conclusion

- Developed a 3-sector growth model with imperfect competition



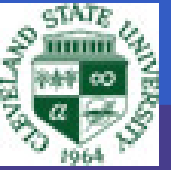
Conclusion

- Developed a 3-sector growth model with imperfect competition
- Price of Home Appliances can decline without differences in TFP growth rates across sectors

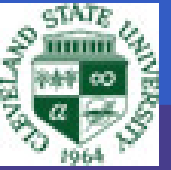


Conclusion

- Developed a 3-sector growth model with imperfect competition
- Price of Home Appliances can decline without differences in TFP growth rates across sectors
- Appliances price decreased at 3.8% per year, short of 10% observed in the data but larger than 1.4% in a perfectly competitive setting

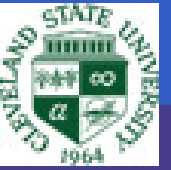


Extensions



Extensions

- N-period OLG model with capital accumulation



Extensions

- N-period OLG model with capital accumulation
- More realistic assumption for assortative matching could make HH choices more interesting