Estimating the Optimal Inflation Target from Micro Price Data

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1 The opinions expressed in this presentation are those of the authors and do not necessarily reflect the views of the Deutsche Bundesbank or the Eurosystem.
Introduction

- Fresh look at micro price data underlying the construction of CPI
  
  Normative inference: optimal inflation target (OIT)

- Construct a rich sticky price model with a product life-cycle

- OIT in the model depends on features of product life-cycle

- Bring model to U.K. micro data: Office of National Statistics (ONS)
Show how to estimate **optimal inflation target** from micro price data:

- to first-order accuracy: directly and in a parameter-free way

- fully nonlinear approach: requires additional parametric assumptions (demand elasticities, price stickiness, etc.)

- estimation works in a setting with sticky prices and historically sub-optimal monetary policy
Introduction

A. Optimal Inflation Rate, Baseline Estimate

Mean estimate and +/- 2 std. dev. error bands

Optimal Inflation

99% Conf. Bands
Optimal inflation target in the model:

Minimizes welfare consequences of relative price distortions
Optimal inflation target in the model:

Minimizes welfare consequences of relative price distortions

Abstract from other factors affecting OITs:

Higher optimal target:
- Lower bound constraints on nominal rates
  (Adam (2006), Gorodnichenko et al. (2012))
- Downward nominal wage rigidity, e.g., Benigno (2011)

Lower optimal target:
- Cash distortions, e.g., Kahn, King, Wolman (2003), Schmitt-Grohé, Uribe (2011)
- Lack of commitment, e.g., Rogoff (1985)
Structure of the Presentation

1. Key Elements of the Price Setting Model
2. Optimal Inflation Target: Theory
3. The UK Micro Price Data
4. Optimal Inflation Target: Estimation Results
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Price Setting Model

- Representative consumer, growth-consistent preferences

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{[C_t V(L_t)]^{1-\sigma} - 1}{1 - \sigma} \right), \]

Expenditure items are a Dixit-Stiglitz aggregate of individual goods

\[ C_{zt} = Z_t \prod_{z=1}^{\infty} (C_{zt})^{\psi_{zt}}, \] with

\[ Z_t \sum_{z=1}^{\infty} \psi_{zt} = 1, \] with

\[ Q_{jzt} \] quality of product \( j \) in item \( z \) at time \( t \).

\[ eC_{jzt} \] physical or not quality-adjusted units.
Price Setting Model

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\[ E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{[C_t V(L_t)]^{1-\sigma} - 1}{1 - \sigma} \right), \]

- \( Z_t \) expenditure items with expenditure weight \( \psi_{zt} \):

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- Expenditure items are a Dixit-Stiglitz aggregate of individual goods

\[ C_{zt} = \left( \int_0^1 \left( Q_{jzt} \tilde{C}_{jzt} \right)^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}}, \]

\( Q_{jzt} \): quality of product \( j \) in item \( z \) at time \( t \).
\( \tilde{C}_{jzt} \): physical or not quality-adjusted units
Price Setting Model: Turnover

Two levels at which turnover takes place in the economy

- **Item level:** items exit/new items enter/expenditure weights change
  Example: CD-players drop out, get replaced by flash-drive devices

- **Product level:** constant entry and exit of products
  Example: particular flash-drive model exits, a new model enters
Item-level turnover:

- Captures slow moving change in consumption basket:

  Approx. 5% of items enter/exit per year
**Item-level turnover:**

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  **Approx. 5% of items enter/exit per year**

- We do *not* explicitly model item change:

  Theory results are for given items & weights: $Z_t = Z, \psi_{zt} = \psi_z$
**Item-level turnover:**

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- Empirical application: uses $(Z_t, \{\psi_{zt}\}_{z=1}^{Z_t})$ from ONS
**Item-level turnover:**

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  Theory results are for given items & weights: $Z_t = Z, \psi_{zt} = \psi_z$

- Empirical application: uses $(Z_t, \{\psi_{zt}\}_{z=1}^{Z_t})$ from ONS

- Model-based interpretation of item turnover:
  changing consumer tastes (other interpretations possible...)

Adam & Weber (University of Oxford Deutsche Bundesbank) - Optimal Inflation Target - January 2019
Product-level turnover:

- High rate of product entry and exit:
  
  Approx. 8% of products enter/exit per month
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- Exogenous exit and entry probability: \( \delta_z \in (0, 1) \)
Product-level turnover:

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- Exiting products replaced by new product:
  for simplicity assign same product index $j \in [0, 1]$
Price Setting Model: Turnover

**Product-level turnover:**

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Product-level turnover:

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- Interpretation of product turnover: changing consumer tastes
- Alternatively:
Product-level turnover:

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- Alternatively:
  
  - negative productivity shock to old producer
Product-level turnover:

- High rate of product entry and exit:
  - Approx. 8% of products enter/exit per month
- Exogenous exit and entry probability: $\delta_z \in (0, 1)$
- Exiting products replaced by new product:
  for simplicity assign same product index $j \in [0, 1]$
- Interpretation of product turnover: changing consumer tastes
- Alternatively:
  - negative productivity shock to old producer
  - new product in quality-adjusted terms cheaper & perf. substitute
Model features two types of flexible fundamental dynamics:

- **Quality growth dynamics**: evolution of quality of new products
- **Productivity growth dynamics**: evolution of productivity over time

Both dynamics are item specific: allowed to differ across $z$!
Product quality dynamics (in item $z$):

For product $j$ entering in time $t$:

$$Q_{jzt} = Q_{zt} \cdot \varepsilon_{jzt}$$

- **common time-trend**
- **idiosyncratic**
Product quality dynamics (in item $z$):

- For product $j$ entering in time $t$:

$$Q_{jzt} = Q_{zt} \cdot \varepsilon_{jzt}$$

  - common time-trend
  - idiosyncratic

- Following entry: product quality constant over product lifetime
  new qualities = new products
Price Setting Model: Quality Dynamics

Product quality dynamics (in item $z$):

- For product $j$ entering in time $t$:
  \[ Q_{jzt} = Q_{zt} \cdot \epsilon_{jzt} \]

  - Common time-trend $Q_{zt}$
  - Idiosyncratic $\epsilon_{jzt}$

- Following entry: product quality constant over product lifetime
  new qualities = new products

- Idiosyncratic quality: $\epsilon_{jzt} \sim iiQ_z$ with $E\epsilon_{jzt}^Q = 1$. 
Price Setting Model: Quality Dynamics

Product quality dynamics (in item $z$):

- For product $j$ entering in time $t$:
  \[
  Q_{jzt} = Q_{zt} \cdot \varepsilon_{jzt}
  \]
  - common time-trend
  - idiosyncratic quality:

- Following entry: product quality constant over product lifetime
  - new qualities $=$ new products

- Idiosyncratic quality: $\varepsilon_{jzt} \sim iiQ_z$ with $E \varepsilon_{jzt}^Q = 1$.

- The common time-trend evolves according to
  \[
  Q_{zt} = q_{zt} Q_{zt-1} \text{ with } q_{zt} = q_z \varepsilon_{zt}^q,
  \]
  where $E \varepsilon_{zt}^q = 1$ and
  \[
  q_z : \text{mean quality growth for products in item } z
  \]
Price Setting Model: Productivity Dynamics

Product output (in physical units):

$$\tilde{Y}_{jzt} = A_{zt} \cdot G_{jzt} \cdot (K_{zjt})^{1−\frac{1}{\phi}} (L_{zjt})^{\frac{1}{\phi}}$$

- General TFP ($A_{zt}$)
- Product-specific TFP ($G_{jzt}$)
Price Setting Model: Productivity Dynamics

- Product output (in physical units):

\[
\tilde{Y}_{jzt} = \underbrace{A_{zt}}_{\text{General TFP}} \cdot \underbrace{G_{jzt}}_{\text{Product-specific TFP}} \cdot (K_{zjt})^{1-\frac{1}{\phi}} (L_{zjt})^{\frac{1}{\phi}}
\]

- General TFP:

\[
A_{zt} = a_{zt} A_{zt-1}, \quad \text{with} \quad a_{zt} = a_z \epsilon_{zt}^a,
\]
Price Setting Model: Productivity Dynamics

- Product output (in physical units):

\[ \tilde{Y}_{jzt} = \sqrt{A_{zt}} \cdot G_{jzt} \cdot (K_{zjt})^{1-\frac{1}{\phi}} (L_{zjt})^{\frac{1}{\phi}} \]

- General TFP:

\[ A_{zt} = a_{zt} A_{zt-1}, \quad \text{with} \quad a_{zt} = a_z \epsilon_{zt}^a, \]

- Product specific TFP:

  - random draw at time of product entry \( t \) : \( G_{jzt} \sim iiG_z \)
  - experience accumulation over the product life:

\[ G_{jzt} = g_{zt} G_{jzt-1} \quad \text{with} \quad g_{zt} = g_z \epsilon_{zt}^g \]

\( g_z \): mean experience product growth for products in item \( z \)
Model with Calvo-type price setting frictions at the product level

- At time of product entry: firms can freely choose product price
- Subsequently: *item-specific* stickiness $\alpha_z \in [0, 1)$
Can augment Calvo model with "temporary price" adjustments/sales (Kehoe and Midrigan (2015)):

- Calvo price is the "list price" or "regular price"
- Each period: prob. $\alpha_T \in (0, 1)$ to set a temporary price for one period
- Optimal temporary price: flex price

Largely abstract from temporary prices in presentation
**Price Setting Model: Quality-Adjusted Prices**

- Quality-adjusted product price

\[ P_{jzt} = \frac{\tilde{P}_{jzt}}{Q_{jzt}} \]

\( \tilde{P}_{jzt} \): price per physical unit

- In line with ONS, quality-adjusted price indices

**Item Price Index**

\[ P_{zt} = \left( \int_0^1 \left( \frac{\tilde{P}_{jzt}}{Q_{jzt}} \right)^{1-\theta} \, dj \right)^{\frac{1}{1-\theta}} \]

**General Price Index**

\[ P_t = \prod_{z=1}^{Z_t} (P_{zt})^{\psi_{zt}} \]

- Optimal inflation target is for the quality-adjusted price index!
Optimal (quality-adjusted) reset price $P^{*}_{jzt}$:

$$\frac{P^{*}_{jzt}}{P_{zt}} \left( \frac{Q_{jzt-sjt} G_{jzt}}{Q_{zt}} \right) = \left( \frac{\theta}{\theta - 1} \frac{1}{1 + \tau} \right) \frac{N_{zt}}{D_{zt}} \frac{P_{t}}{P_{zt}},$$

$N_{zt}, D_{zt}$ are discounted expected marginal revenues and costs.
We have

\[ N_{zt} = \frac{MC_t}{P_t A_{zt} Q_{zt}} + E_t \alpha_t (1 - \delta_t) \Omega_{t,t+1} Y_{zt+1} \left( \frac{P_{zt+1}}{P_{zt}} \right)^\theta q_{zt+1} g_{zt+1} N_{zt+1} \]

\[ D_{zt} = 1 + \alpha_t (1 - \delta_t) E_t \Omega_{t,t+1} Y_{zt+1} P_t \left( \frac{P_{zt+1}}{P_{zt}} \right)^\theta D_{zt+1}. \]

\( MC_t \): nominal marginal costs of production
\( \Omega_{t,t+1} \): stochastic discount factor
\( Y_{zt} \): item-level output (in constant quality units), defined as:

\[ Y_{zt} = \left( \int_0^1 \left( Q_{jzt} \tilde{Y}_{jzt} \right)^{\frac{\theta-1}{\theta}} \, dj \right)^{\frac{\theta}{\theta-1}} \]
Structure of the Presentation

1. Key Elements of the Price Setting Model
2. Optimal Inflation Target: Theory
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4. Optimal Inflation Target: Estimation Results
Derive closed-form results for the optimal steady-state inflation rate.

Interpret optimal steady-state inflation = optimal inflation target

Aggregate shocks:
cause only temporary deviation of opt. inflation from OIT

Changing item structure $\implies$ changes in OIT over time
A steady state is a situation with a fixed set of items \( Z_t = Z \), constant item-weights \( \psi_{zt} = \psi_z \), no item-level disturbances \( (g_{zt} = g_z, q_{zt} = q_z, a_{zt} = a_z) \), and a constant (potentially suboptimal) inflation rate \( \Pi \).

The following idiosyncratic shocks continue to operate in a steady state:

- product entry and exit shocks
- shocks to price adjustment opportunities, and
- initial shocks to product quality & productivity, as implied by \( Q_z \) and \( G_z \).
Theorem

Assume an efficient output subsidy \( \theta / ((1 - \tau)(\theta - 1)) = 1 \) and consider the limit \( \beta(\gamma)^{1-\sigma} \to 1 \), where \( \gamma \) is the growth trend of the aggregate economy. The inflation rate \( \Pi^* \) that maximizes steady state utility is

\[
\Pi^* = \sum_{z=1}^{Z} \omega_z \left( \frac{g_z \gamma_z}{q_z \gamma} \right),
\]

where \( \gamma_z / \gamma = a_z q_z / \prod_{z=1}^{Z} (a_z q_z)^{\psi_z} \) and the weights \( \omega_z \geq 0 \) are given by

\[
\omega_z = \frac{\tilde{\omega}_z}{\sum_{z=1}^{Z} \tilde{\omega}_z}, \quad \text{where}
\]

\[
\tilde{\omega}_z = \frac{\psi_z \theta \alpha_z (1 - \delta_z) (\gamma / \gamma_z \Pi^*)^{\theta} (q_z / g_z)}{\left[ 1 - \alpha_z (1 - \delta_z) (\gamma / \gamma_z \Pi^*)^{\theta} q_z / g_z \right]} \left[ 1 - \alpha_z (1 - \delta_z) (\gamma / \gamma_z \Pi^*)^{\theta-1} \right].
\]
Generalizes Adam and Weber (AER, forthcoming) to a setting with item and product-level heterogeneity.

Unlike in earlier work: optimal inflation rate ceases to implement efficient relative prices.

Each item \( z \in Z \) has its own optimal inflation rate \( \Pi^*_z = g_z / q_z \).

Weights \( \omega_z \) and relative growth rates \( \gamma_z / \gamma \) determine how to optimally trade off between items.

Optimal weights \( \omega_z \) not easy to interpret....
Corollary

To a first-order approximation, the optimal steady-state inflation rate is

$$\Pi^* = \sum_{z=1}^{Z} \psi_z \left( \frac{g_z \gamma_z}{q_z \gamma} \right),$$

(3)

where the approximation has been taken around a point, in which $\frac{g_z \gamma_z}{q_z \gamma}$ and $\alpha_z (1 - \delta_z) (\gamma / \gamma_z)^{\theta-1}$ are constant across sectors $z = 1, \ldots, Z$.

- To first order: weights are simply ONS expenditure weights $\psi_z$!
- Inflation rates identify $\gamma_z / \gamma = \frac{P / P_{-1}}{P_z / P_{z,-1}}$
- Remains to identify $g_z / q_z$: can estimate from micro data
Proposition

Consider a steady state with (possibly suboptimal) inflation. In price adjustment periods, the optimal reset price $P^*_{jzt}$ satisfies

$$\ln \frac{P^*_{jzt}}{P_{zt}} = c_{jz} - \ln \left( \frac{g_z}{q_z} \right) \cdot s_{jzt}.$$ 

$s_{jzt}$ : age of product $j$ in item $z$

$c_{jz}$ : product-item-specific intercept

- $g_z > 1$ : experience accumulation in productivity $\Rightarrow$ optimal relative price falls over product lifetime

- $q_z > 1$ : newer products higher quality, in constant-quality terms their prices are lower $\Rightarrow$ optimal relative price rises
Economic insight:

- trend in relative reset prices \( \frac{g_z}{q_z} \) is the trend under flexible prices!

- sticky prices lead only to \textit{temporary deviations} from the relative price trend under flexible prices

- Not special to the Calvo setup & equally true for menu-cost models: sS-bands limit price deviation from flex-price trend
Optimal Inflation Rate

- Can estimate the relative price trend using

\[ \ln \frac{P_{jzt}}{P_{zt}} = c_{jz} - \ln \frac{g_z}{q_z} \cdot s_{jzt} + \epsilon_{jzt} \]

\( \epsilon_{jzt} \): idiosyncratic price deviations due to price stickiness

(with aggregate shocks may also capture these)
Can estimate the relative price trend using

\[ \ln \frac{P_{jzt}}{P_{zt}} = c_{jz} - \ln \frac{g_z}{q_z} \cdot s_{jzt} + \varepsilon_{jzt} \]

\( \varepsilon_{jzt} \): idiosyncratic price deviations due to price stickiness

(with aggregate shocks may also capture these)

Estimate one trend \( \frac{g_z}{q_z} \) for each item \( z \), then aggregate according to

\[ \Pi^* = \sum_{z=1}^{Z} \psi_z \left( \frac{g_z \gamma_z}{q_z \gamma} \right) \]
Can estimate the relative price trend using

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Estimate one trend \( \frac{g_z}{q_z} \) for each item \( z \), then aggregate according to

\[ \Pi^* = \sum_{z=1}^{Z} \psi_z \left( \frac{g_z}{q_z} \gamma_z \right) \]

Use ONS item composition & weights at any time \( t \)
Can estimate the relative price trend using

$$\ln \frac{P_{jzt}}{P_{zt}} = c_{jz} - \ln \frac{g_z}{q_z} \cdot s_{jzt} + \varepsilon_{jzt}$$

$\varepsilon_{jzt}$: idiosyncratic price deviations due to price stickiness

(with aggregate shocks may also capture these)

Estimate one trend $\frac{g_z}{q_z}$ for each item $z$, then aggregate according to

$$\Pi^* = \sum_{z=1}^{Z} \psi_z \left( \frac{g_z \gamma_z}{q_z \gamma} \right)$$

Use ONS item composition & weights at any time $t$

Get (slowly) time-varying inflation target $\Pi^*$ as items (slowly) change
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U.K. Micro Price Data

- Monthly data with approx. 29m price observations
- Not all products uniquely identified: ONS does not disclose complete location information
- Eliminate not uniquely identified price quotes: leaves 24.5m prices
- Some price quotes considered "invalid" by ONS for other reasons: leaves 22.8 million observations
- Split product price series at ONS substitutions flags or at observation gaps to insure we follow the same product over time
### Table: Basic Data Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td># price quotes in raw data</td>
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<tr>
<td># items</td>
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<td># regions</td>
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<td># price quotes in replicated items</td>
<td>21,215,430</td>
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<tr>
<td># product identifiers</td>
<td>6,130,311</td>
</tr>
</tbody>
</table>
U.K. Micro Price Data

- **Replication check:**
  - aggregate individual prices to item indices using ONS methodology
  - compare our item indices to ONS indices

- Correlations with ONS index generally high:
  \( >0.95 \) for vast majority of items

- Omission of "duplicate prices" sometimes drives a wedge

- Use only items for which RMSE between our index and ONS index is below 0.02: \( \approx 93\% \) of valid price quotes

- Work with 21.2m price observations as our base sample
U.K. Micro Price Data

A. Distribution of RMSEs

B. Distribution of Correlations

C. RMSE and Correlation

- RMSE (left scale)
- Correlation (right scale)
Table: Descriptive Statistics For Replicated Items

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of items</td>
<td>1093</td>
</tr>
<tr>
<td>Number of Price Quotes</td>
<td></td>
</tr>
<tr>
<td>Minimum across items</td>
<td>253</td>
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<tr>
<td>Median across items</td>
<td>15458</td>
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<tr>
<td>Mean across item</td>
<td>19410.3</td>
</tr>
<tr>
<td>Maximum across items</td>
<td>81840</td>
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<tr>
<td>Number of Products</td>
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<tr>
<td>Minimum across items</td>
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<tr>
<td>Median across items</td>
<td>470</td>
</tr>
<tr>
<td>Mean across item</td>
<td>560.9</td>
</tr>
<tr>
<td>Maximum across items</td>
<td>2080</td>
</tr>
</tbody>
</table>
U.K. Micro Price Data

A. Number of Items

- Replicated Items
- ONS Items

B. Share of Replicated Items

- Expenditure Share
- Relative Number
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Benchmark Results - All Prices in Estimation

A. Optimal Inflation Rate, Baseline Estimate

B. Item-Level Optimal Inflation Rates

Prob

\( II_\zeta \) in % per year (truncated)
All Prices vs. Only Reset Prices in Estimation

Optimal Inflation Rate, Reset-Price vs Baseline Estimate

- Baseline Estimate
- Reset-Price Estimate
- 99% Conf. Bands

% per year

Source of the Upward Trend (All Prices)

Beginning versus end of sample distributions:

A. Weighted Item-Level Optimal Inflation Rates

![Graph showing weighted item-level optimal inflation rates for 1996 and 2016.](image)

- $\Pi^*_z$ in % per year (truncated)
- Prob

Adam & Weber  Optimal Inflation Target  January 2019
Source of the Upward Trend

A. Dynamic Olley-Pakes Decomposition

B. Number of Items

Dynamic Olley-Pakes Decomp. according to Melitz and Polanec (RAND, 2015)
PG: Baseline - no filter; SFD: Prices with ONS sales flag deleted; NSA/NSB: Nakamura-Steinsson (2008) sales filter version
A/B; REG: Kehoe and Midrigan (2015) regular prices; RGF: regular prices with only sales prices filtered, following Kryvstov
and Vincent (2017).
Theory:

Deviation of actual inflation $\Pi_z$ from optimal inflation $\Pi_z^*$

$\Rightarrow$ excess price dispersion

Question: can we find this relationship in the U.K. price data?

Nakamura, Steinsson, Sun, Villar (2018):

Price dispersion effects elusive in U.S. data....
Theory implies (second-order approximation):

\[ \ln \left( \frac{\Delta z}{\Delta^e z} \right) = c_z \cdot (\Pi_z - \Pi^*_z)^2 \]

where

\[ \Delta z / \Delta^e z \geq 1 : \text{ a measure of excess price dispersion} \]
\[ c_z > 0 : \text{ depends on } \alpha_z, \delta_z, ... \]

Optimal inflation estimates \( \Pi^*_z \) for more than 1000 items \( z \)

Can compute average inflation in each item \( E[\Pi_{zt}] \)

Does \( (\Pi^*_z - E[\Pi_{zt}])^2 \) predict excess price dispersion?
On the previous slide:

\[ \frac{\Delta z}{\Delta^e_z} = \int_0^1 \left( \frac{Q_{zt}}{G_{jzt} Q_{zt-sjt}} \right) \left( \frac{P_{jzt}}{P_{zt}} \right)^{-\theta} \, dj / \left( \int_0^1 \left( \frac{Q_{zt}}{G_{jzt} Q_{zt-sjt}} \right)^{1-\theta} \, dj \right)^{\frac{1}{1-\theta}} \]

and

\[ c_z = \frac{1}{2} \theta \left[ \frac{\alpha^z (1 - \delta^z)(\Pi^*_z)^{\theta-1}}{(1 - \alpha^z (1 - \delta^z)(\Pi^*_z)^{\theta-1})^2 (\Pi^*_z)^2} \right] > 0 \]
Measure of excess price deviation:

- For each product $j$ in item $z$:
  - compute std. dev. of deviations from estimated rel. price trend

- Take the median standard deviation $\sigma_{zm}^m$ in item $z$ & estimate

$$\sigma_{zm}^m = a + b (\Pi_z^* - E[\Pi_{zt}]) + c (\Pi_z^* - E[\Pi_{zt}])^2$$

- Theory implies

$$b = 0 \text{ and } c > 0$$

(theory also implies $a = 0$, but not robust to measurement & estimation error)
<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Estimate</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td>0.0288</td>
<td>34.024</td>
</tr>
<tr>
<td>$b$</td>
<td>-0.0235</td>
<td>-1.3127</td>
</tr>
<tr>
<td>$c$</td>
<td>1.3979</td>
<td>4.7303</td>
</tr>
</tbody>
</table>

Minimum $\Pi^*_z - \Pi_z = 0.84\%$ per year $= 1.3862$

Robustly get $c > 0$ and stat. significant, for

- sales filtered data
- measuring deviations from product-specific age trends
- mean instead of median std. dev.
Deviations from Optimal Inflation: Price Dispersion?

Median of std(ξ_{i,t}) for

π_{i,t}^* - π_{i,t}

Figure 1: Scatter plot showing the relationship between the median standard deviation of inflation shocks (ξ_{i,t}) and the deviation from the optimal inflation target (π_{i,t}^* - π_{i,t}).
Conclusions

- Estimate optimal inflation target directly from micro price trends
- Relative price trends with flex prices =
  Relative price trends with sticky prices & sub-opt. inflation
- Relative price trends determine optimal inflation
- Optimal inflation:
  - minimizes relative price distortions by minimizing need for price adjustments
- Empirically, excess price dispersion moves in line with theory: increases as actual inflation deviates from opt. inflation
- Optimal U.K. inflation target slight upward trend:
  1996: 1.4%-1.8% $\Rightarrow$ 2016: 2.6%-3.2%