

# How to Solve the Price Puzzle?

## A Meta-Analysis

Marek Rusnak   Tomas Havranek   Roman Horvath

Charles University, Prague

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# Outline

- 1 Introduction
- 2 Data
- 3 Heterogeneity
- 4 Best Practice

# Definition of the Price Puzzle

- The central bank increases the interest rate:
  - Prices should fall.
  - But a half of empirical studies report that prices increase!
- Price puzzle—the short-run increase in prices after monetary tightening.
- Explanation 1: Caused by the cost channel (real increase in prices).
- Explanation 2: Caused by omitted variables (econometric misspecifications).

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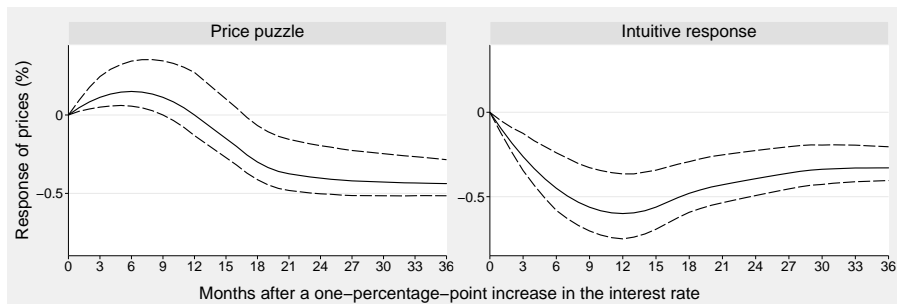
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# Impulse Responses

- Vector autoregressions (VARs) used to estimate the effects of monetary policy.
- The results reported graphically as impulse response functions.
- How do prices change after the central bank increases the interest rate by one percentage point?





# Meta-Analysis: More than a Literature Survey

- The quantitative method of research synthesis.
- We are interested in the heterogeneity among reported impulse responses.
- Do results systematically depend on the methodology?
- Common method in economics:

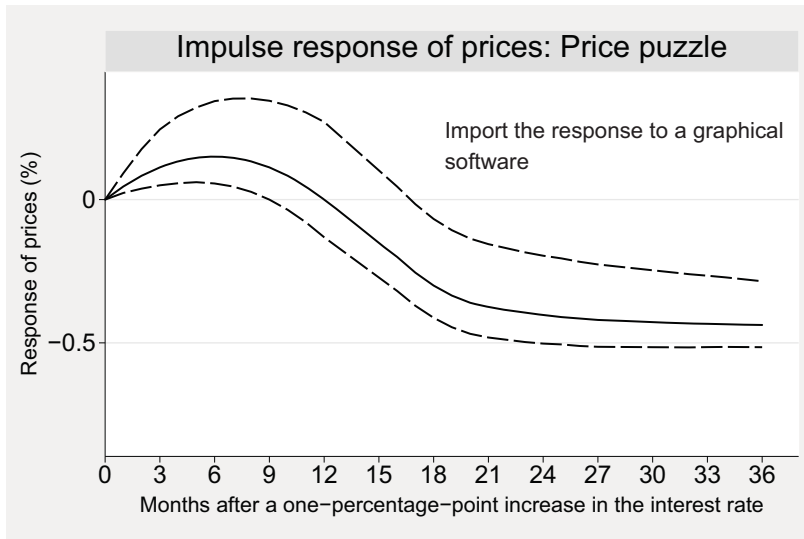
## Meta-analysis in top journals

Card and Krueger (1995, AER), Smith and Huang (1995, JPE), Stanley (2001, JEconPersp), Görg and Strobl (2001, EJ), Disdier and Head (2008, REStat), Card et al. (2010, EJ).

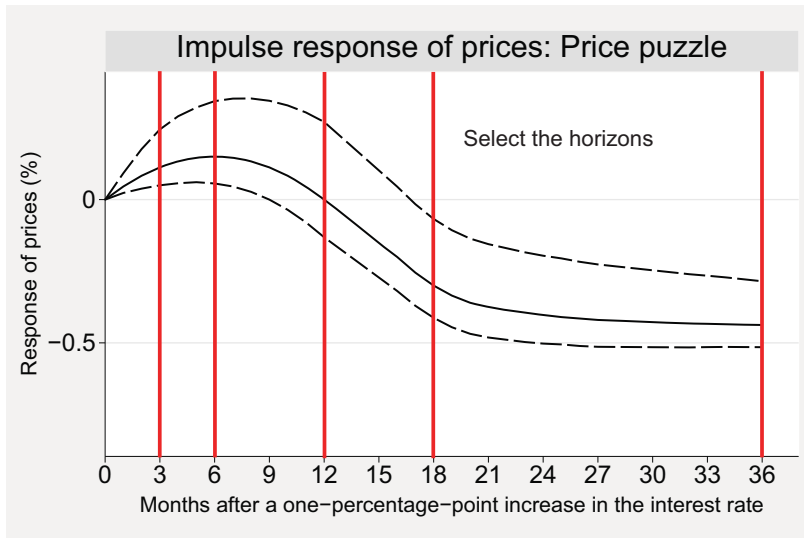
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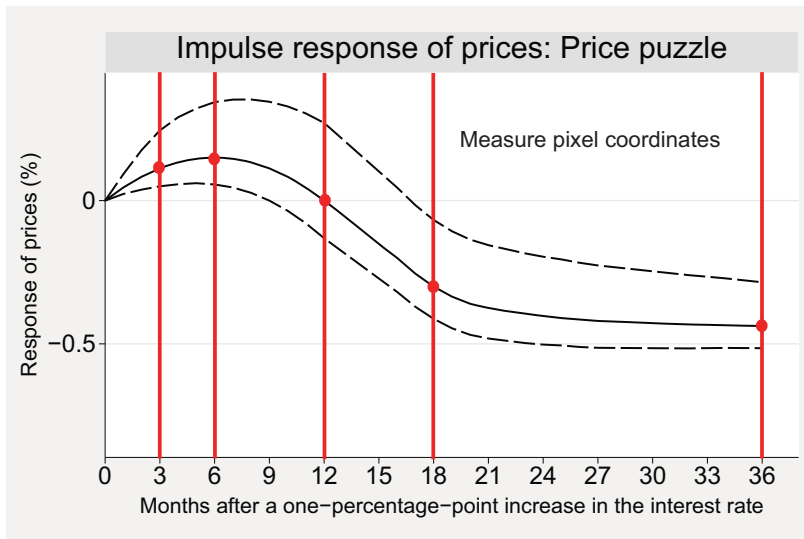
# Coding of Impulse Responses



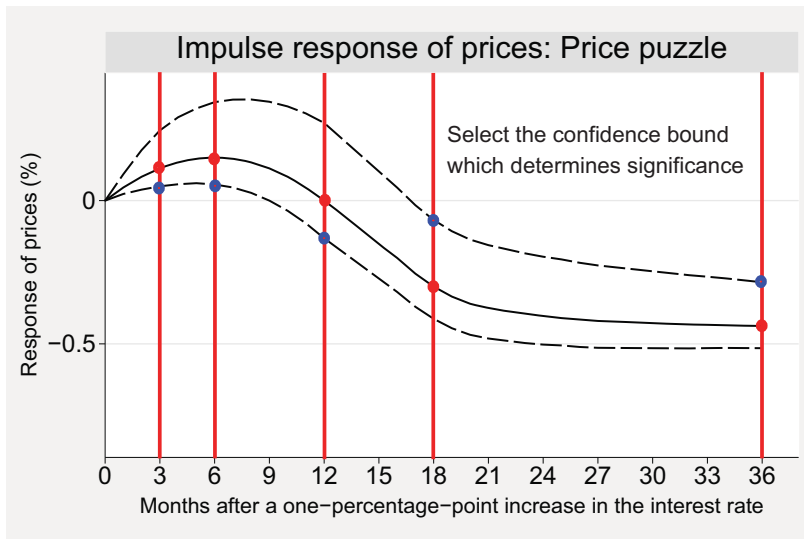
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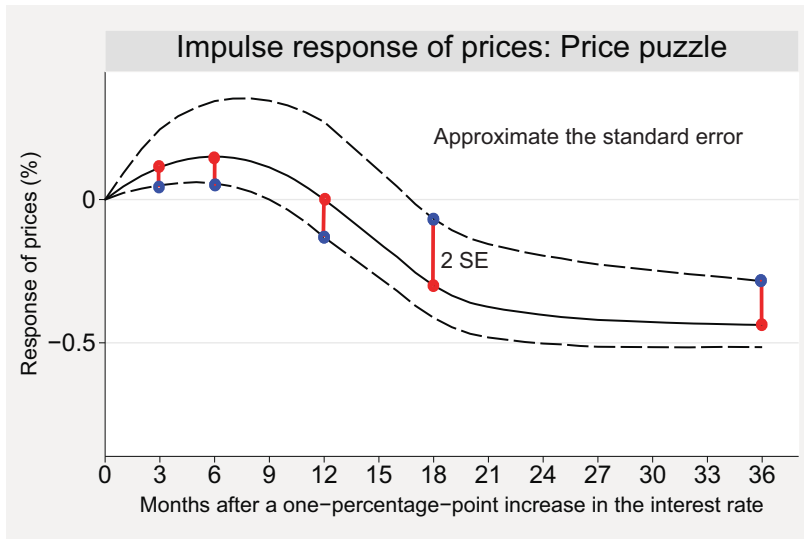
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# Literature Selection

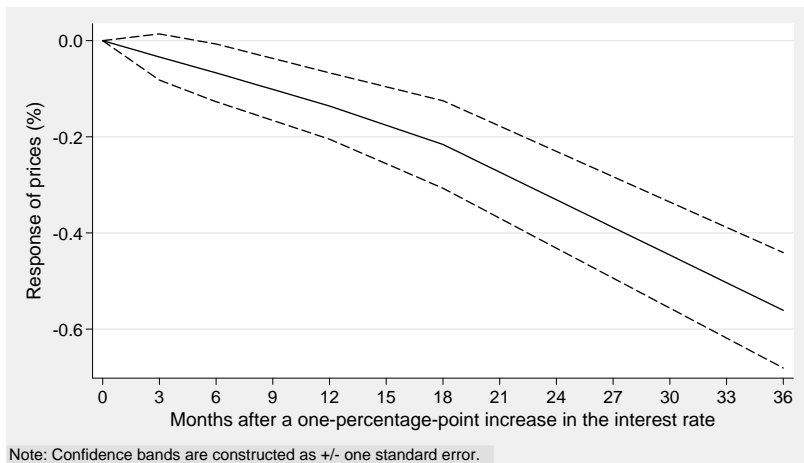
- We searched for **journal articles** in EconLit, Scopus, and RePEc.
- We were looking for empirical papers using VARs to estimate the effects of a shock to the **interest rate** on the **price level**.
- 70 articles contained all the information we needed.



# Data Properties

- We use all impulse responses: more than 1,000 estimates collected.
- All primary studies together use 2,500 unique combinations of countries and quarters.
- Evidence on 31 countries produced by 103 researchers.

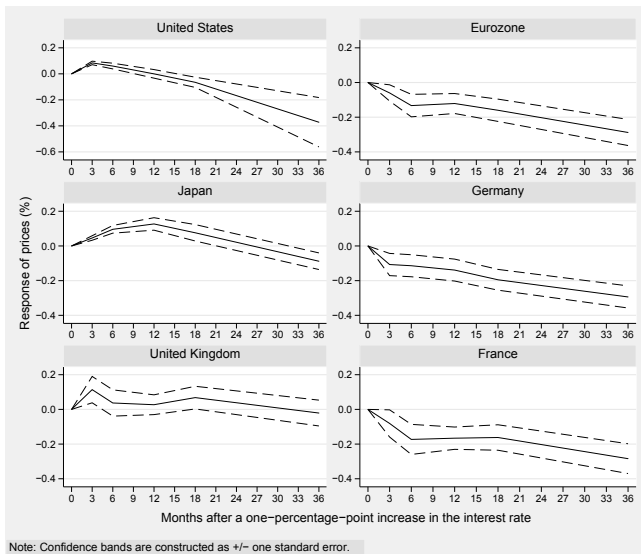
# Average Impulse Response is Intuitive



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# Cross-Country Differences in Monetary Transmission



# Country Heterogeneity

What may cause cross-country differences? For example:

- 1 With higher average **inflation** the effect of monetary policy on prices gets weaker (lower credibility).
- 2 With a higher **openness** of the economy the effect on prices gets stronger (exchange rate channel).
- 3 With a higher degree of central bank **independence** the effect on prices gets stronger (higher credibility).

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# Method Heterogeneity

Some methodologies may cause the price puzzle. According to the literature:

- 1 Omitted **commodity prices** (no forward-looking element).
- 2 GDP used instead of **output gap** (no information about potential output).
- 3 Recursive identification used instead of a **structural VAR** (consistence with theory).



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# What Explains Different Impulse Responses?

- We regress the collected responses ( $\hat{\beta}_{ij}$ ) on the characteristics of countries, methods, and authors ( $X_{kij}$ ).
- The specification is divided by SE to give more weight to precise results:

$$\frac{\hat{\beta}_{ij}}{SE_{ij}} = \beta_0 + \zeta_j + \sum_k \frac{X_{kij}}{SE_{ij}} + \epsilon_{ij}. \quad (1)$$

- Control for dependence within studies  $j$  (mixed-effects weighted least squares).

# Results: It Depends on the Horizon

## Short vs. long run

- Methodology determines the reported short-run response.
  - Misspecifications systematically influence the results and contribute to the price puzzle.
- Country heterogeneity determines the long-run response.
  - Estimated signs for country-level variables are consistent with the intuition given above.

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# Rationale for Best Practice

## From the multivariate meta-regression

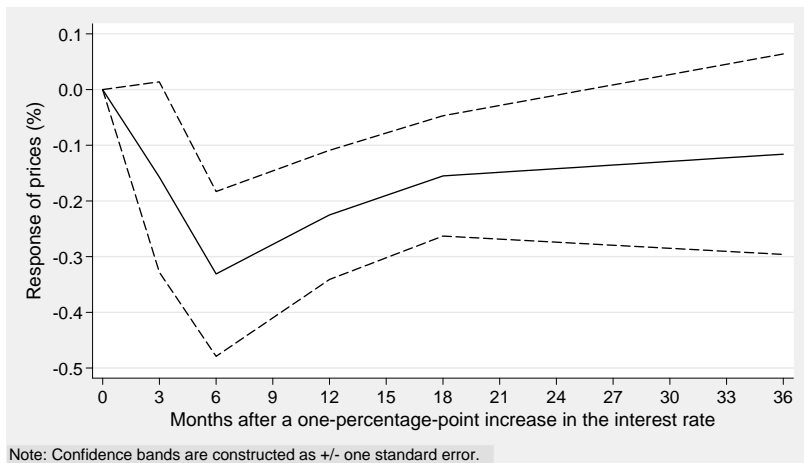
- We have found that misspecifications have systematic influence on results.
- We have found that the number of observations and age of data are important.

How to use this information to improve our estimate of the average impulse response?

# Definition of Best Practice

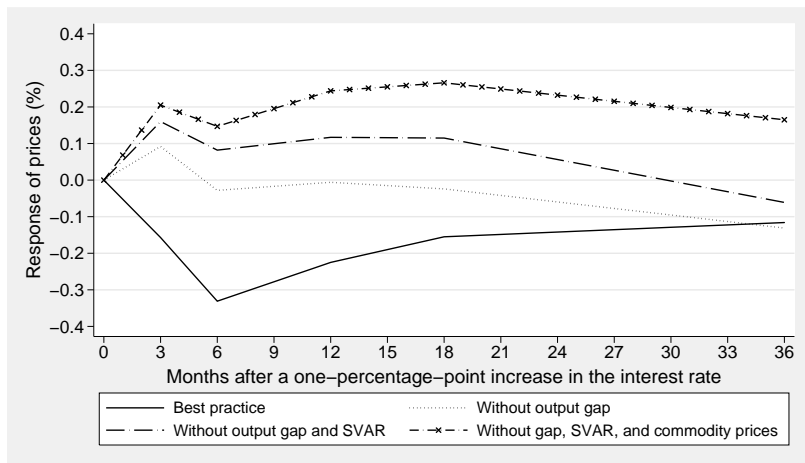
- We plug in sample maximums for the number of observations, new data, . . . , control for all well-known misspecifications.
- Country-level variables and author characteristics are set to sample means.
- Best practice is subjective. But our results are robust to many possible definitions.

# Best-Practice Impulse Response: Fast Transmission





# Misspecifications Cause the Price Puzzle



# Conclusion

## Summary

- 1 The reported price puzzle in the short run is due to misspecifications.
- 2 The long-run response is driven by structural country-specific characteristics.
- 3 On average, the transmission of monetary policy shocks is relatively fast.

# Project Website: [www.meta-analysis.cz](http://www.meta-analysis.cz)

## how to solve the price puzzle? » online appendix

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### abstract

The short-run increase in prices following an unexpected tightening of monetary policy constitutes a frequently reported puzzle. Yet the puzzle is surprisingly easy to explain away when all published models are quantitatively reviewed. We collect about 1000 point estimates of impulse responses from 70 articles using vector autoregressions (VARs) and present a simple method of research synthesis for graphical results. Our findings indicate publication selection in favor of the intuitive response of prices to a tightening. The estimates depend systematically on study design: when misspecifications are filtered out, the price puzzle disappears. The long-run response is driven by the structural characteristics of the economy.

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