Should we believe in HANK?

Evidence from size-persistence tradeoff.

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NES x HSE

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What is HANK?

$$\text{NK} = \text{New Keynesian} = \text{Monetary Policy is not Neutral}$$

$$\text{RANK} = \text{Representative Agent} + \text{NK}$$

$$\text{TANK} = \text{Two-Agent}^{1} + \text{NK} = \text{One agent is Spender, one is Saver} + \text{NK}$$

$$\text{HANK}^{2} = \text{Heterogeneous Agent+NK} = \text{Heterogenity in saving portfolio+NK}$$

(?, ?)

[1] Sometimes referred as Spender-Saver Model

[2] The version by ? (?)

Outcomes of ? (?) model

? (?) HANK model outcomes:

1. Size-Persistence trade-off: Cumulative elasticity of aggregate consumption declines with the increase in autocorrelation of monetary shock in a nonlinear manner.
2. Inflation-Output Tradeoff: the same Taylor rule shocks lead to the increased effects in Inflation-Output tradeoff.

Picture of Size-Persistence trade-off

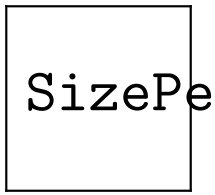


Figure: The difference between the New Keynesian models from ? (?)

Size-Persistent tradeoff by ? (?), formally

$$\textit{RANK:} \quad \frac{d}{d\rho}\frac{-d\log C_0}{dR_0} = 0 \tag{1}$$

$$\textit{TANK:} \quad \frac{d}{d\rho}\frac{-d\log C_0}{dR_0} \leq 0^3 \tag{2}$$

$$\textit{HANK:} \quad \frac{d}{d\rho}\frac{-d\log C_0}{dR_0} < 0 \quad \& \quad \frac{d^2}{d\rho^2}\frac{-d\log C_0}{dR_0} < 0 \tag{3}$$

[3] Depending on the government adjustment.

Related literature

Main work

Model by ? (?)

Microdata

- Working paper by ? (?) find Inconsistent Evidence of HANK – the response is larger than generated by HANK.

MPC

- Estimation of MPC's[a] by ? (?): Increase of MPC is higher in 2008 than in 2011.

[a] Actually MPB, but they argue that it doesn't affect the results

Empirical approach: Monetary Shock Identification I

Identification by ? (?, BRW) two-step approach

1. ? (?) two-step estimation
2. ? (?) heteroskedasticity estimator

Empirical approach: Monetary Shock Identification II

Assume that rate of interest:

$$\Delta R_{i,t} = \alpha_i + \beta_i e_t + \epsilon_{i,t}, \tag{4}$$

Let e_t be normalized to have a one to one relationship with the 2-years Treasury yield. Than:

$$\Delta R_{i,t} = \theta_i + \beta_i \Delta R_{2,t} + \xi_{i,t}, \tag{5}$$

Errors-in-variables![4] It could be mitigated by ? (?) heteroskedasticity estimator. Identification assumption: in dates of FOMC meetings the volatility is externally increased, compared to the week before.
When β_i is estimated, the regression of rate on it to derive e_t.

$$\Delta R_{i,t} = \alpha_i + e_t^{aligned} \hat{\beta}_i + v_{i,t}, \tag{6}$$

[4] If we estimate (**??**) assuming the (**??**) form.

Empirical approach: Main estimation

1. Estimate elasticity of consumption to the deviation of interest rate from its natural value:

$$\log Consumption_w = \alpha_w - \eta_w(r_w - r_w^*) + \varepsilon_w, \tag{7}$$

$$(r_w - r_w^*) = \alpha_w' + \gamma \sum_{0}^{\bar{w}} e^{aligned} + \xi_w \tag{8}$$

2. Estimate the persistence of monetary shock: ARMA(p,q) model, first lag coefficient
3. Regress elasticity of consumption to persistence of monetary shock:

$$\eta = \alpha_i + \beta_{1,i} L(\rho, i) + \xi_i, \tag{9}$$

$$\eta = \alpha_i' + \beta_{1,i} L(\rho, i) + \beta_{2,i} L(\rho, i)^2 + \varepsilon_i, \tag{10}$$

If HANK is the model of choice, we expect $\beta_{1,i}$ in (**??**) to be zero, but $\beta_{2,i}$ in (**??**) to be significantly different from zero!

Data

Monetary Shock identification:

- 1-year, 2-year, 5-year, 7-year, 10-year, 20-year, and 30-year Treasury rates

Size-Persistence Trade-off:

- Consumption as PCECC96 [5] [7]
- Inflation as a change in PCEPILFE[6]
- Natural (neutral) rate of interest by ? (?)[7]
- 2-year Treasury rate as the Short-term rate (r).

[5] Real Personal Consumption Expenditures.

[6] Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index).

[7] Cubic spline interpolation to monthly values.

Results: Monetary Shock Identification I

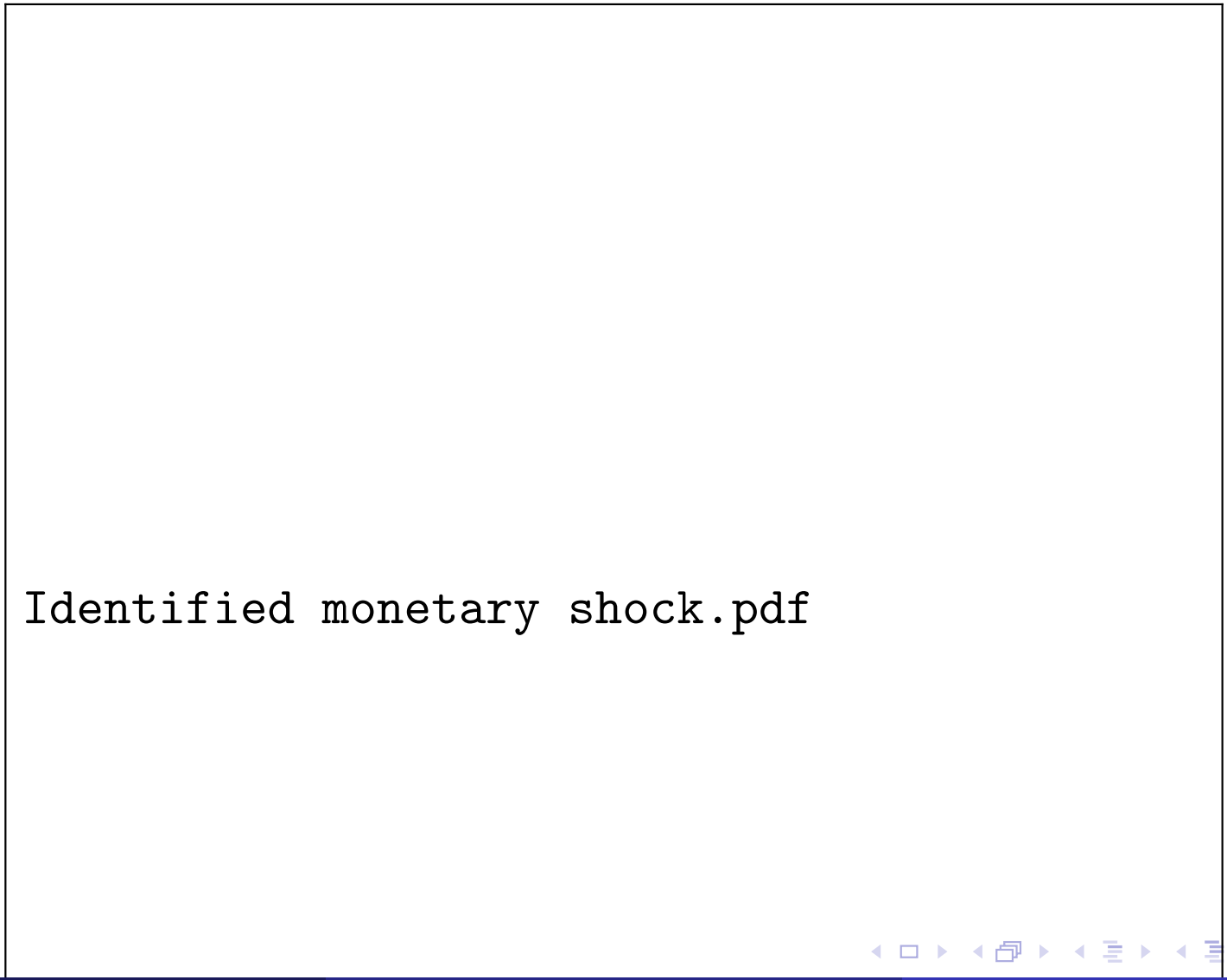
Table: Monetary Shock Identification. First step

	Dependent variable:					
	DGS1	DGS5	DGS7	DGS10	DGS20	DGS30
	(1)	(2)	(3)	(4)	(5)	(6)
DGS2	0.727^{***}	1.029^{***}	0.921^{***}	0.743^{***}	0.316^{**}	0.202
	(0.071)	(0.090)	(0.110)	(0.112)	(0.127)	(0.130)
Constant	-0.005^{***}	-0.001	-0.0002	0.0002	-0.001	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Observations	382	382	382	382	382	382
R^2	0.634	0.766	0.666	0.583	0.327	0.206
Adjusted R^2	0.633	0.765	0.665	0.582	0.325	0.204
Res. Std. Error	0.028	0.035	0.043	0.044	0.049	0.051
Wald test	103.9^{***}	129.9^{***}	70.49^{***}	43.71^{***}	6.201^{**}	2.406
Wu-Hausman	3.699^{*}	0.002	0.259	0.847	9.345^{***}	8.707^{***}

This table reports first stage of ? (?) monetary shock identification procedure for the FOMC announcement from 1994 to the most recent event 2021-04-28 (191 monetary events). OLS standard errors in the parenthesis. F-statistics on instrument insignificance is 44.030^{***}. Wu-Hausman stands for Hausman specification test for the endogeneity of a instrument $\left(\Delta R^{M}_{2,t}, -\Delta R^{NM}_{2,t}\right)'$. *p<0.1; **p<0.05; ***p<0.01.

Results: Monetary Shock Identification II

Figure: Identified Monetary Shocks



Results: Elasticity of consumprion

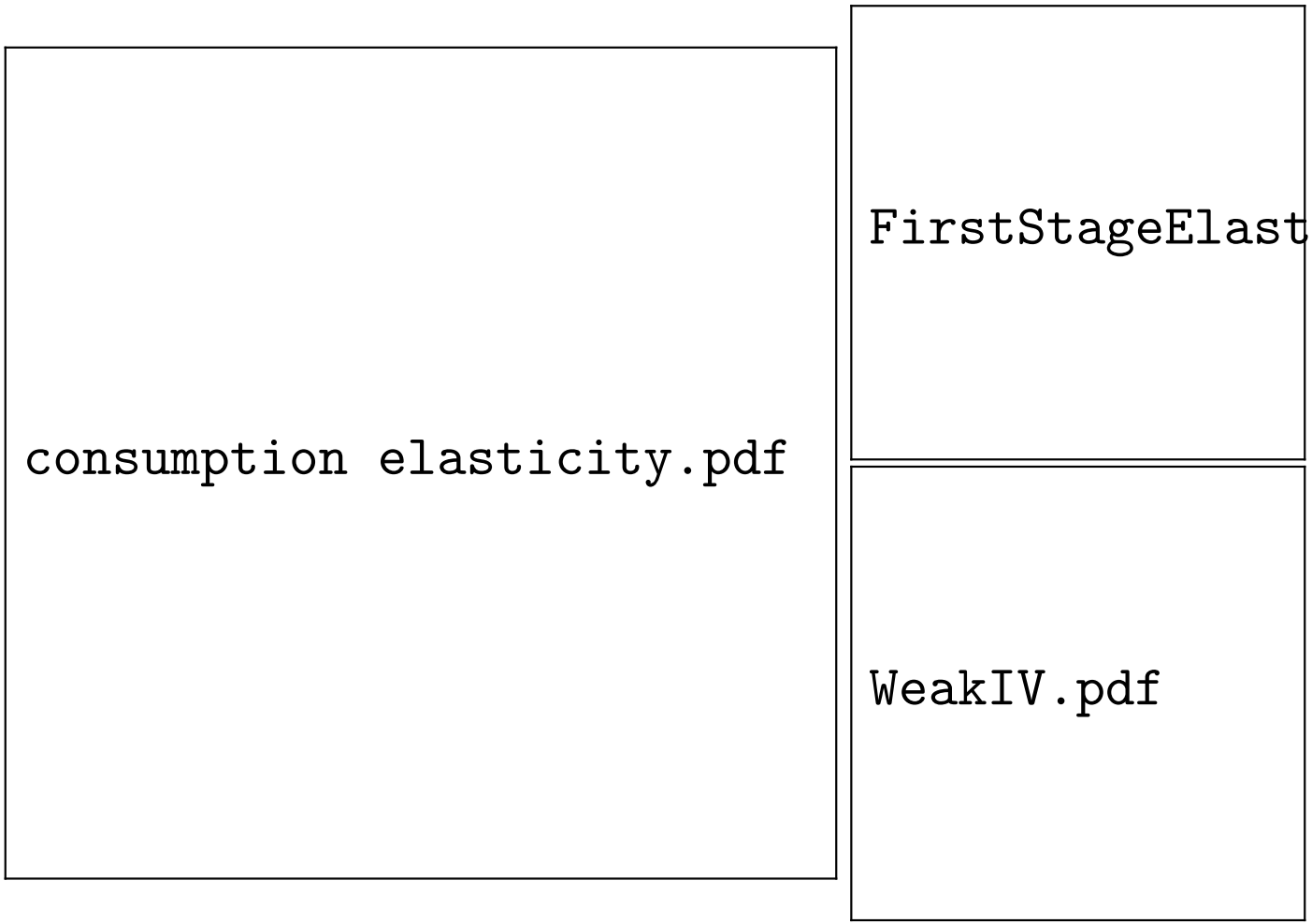
Table: Elasticity of consumption to $(r - r^*)$.

	Dependent variable: log *Consumption*	
	OLS	*IV*
	(1)	(2)
$(r - r^*)$	0.092^{***}	0.197^{***}
	(0.008)	(0.013)
Constant	9.095^{***}	9.050^{***}
	(0.011)	(0.014)
Observations	361	361
R^2	0.255	−0.079
Adjusted R^2	0.253	−0.082
Residual Std. Error	0.207	0.249
F Statistic	122.922^{***}	
Weak instrument		508.1^{***}
Wu-Hausman		622.3^{***}

This table reports the results of estimation of consumption elasticity to the deviation of rate from its neutral (natural) value, $(r - r^*)$. Weak instrument stands for first stage F-statisitic, that indicate, whether the $\hat{R}$ is a strong instrument. Wu-Hausman stands for Hausman specification test for the endogeneity of a instrument $\hat{R}$. *p<0.1; **p<0.05; ***p<0.01

Results: elasticity of consumption. In-windows estimation

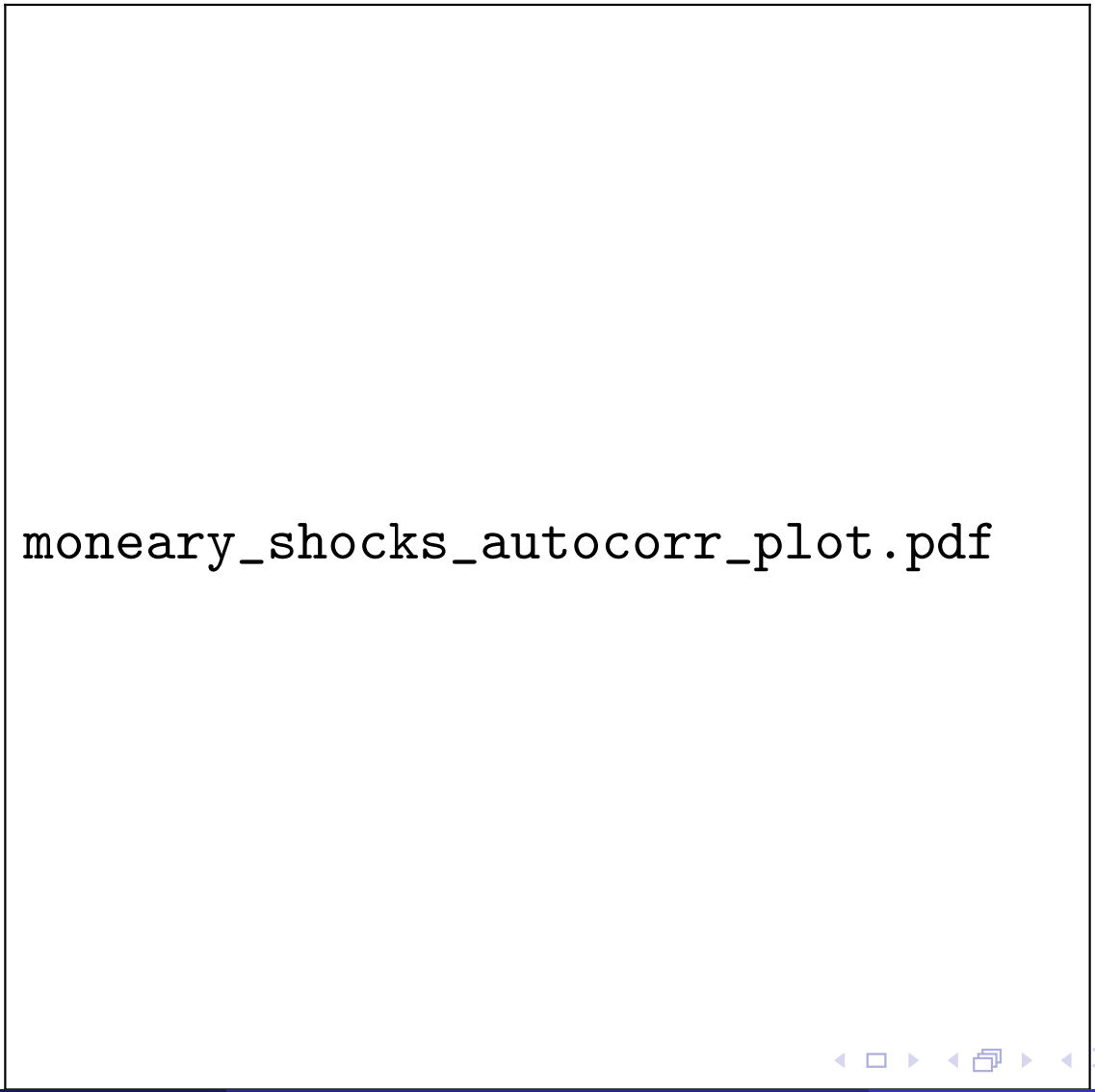
Figure: Elasticity of Consumption to $(r_t - r_t^*)$. Window estimation



Consumption elasticity (panel A) is estimated from 1990-01-01 to the start of coronavirus

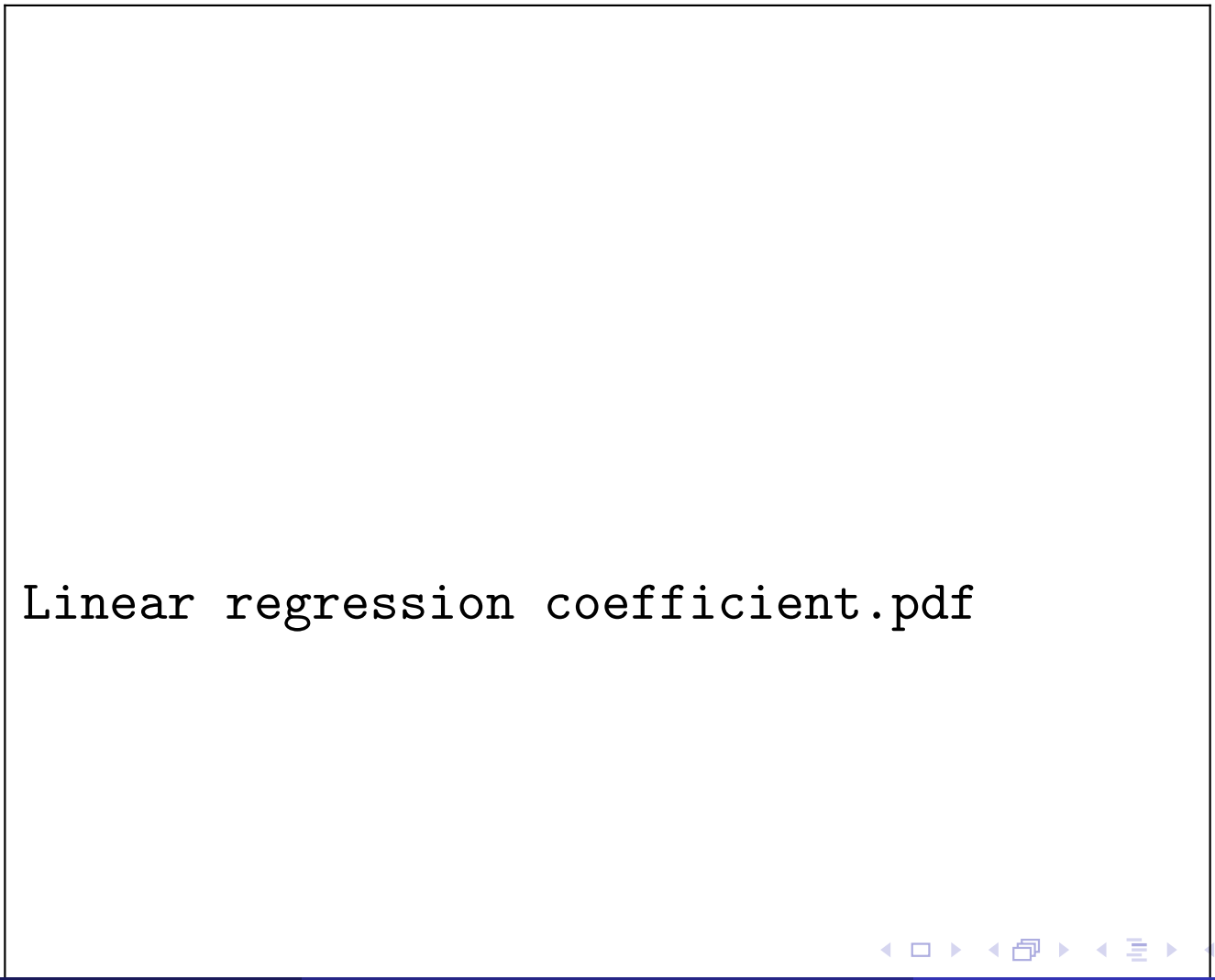
Results: Monetary Shock Persistentce

Figure: Autocorrelation of Monetary Shocks

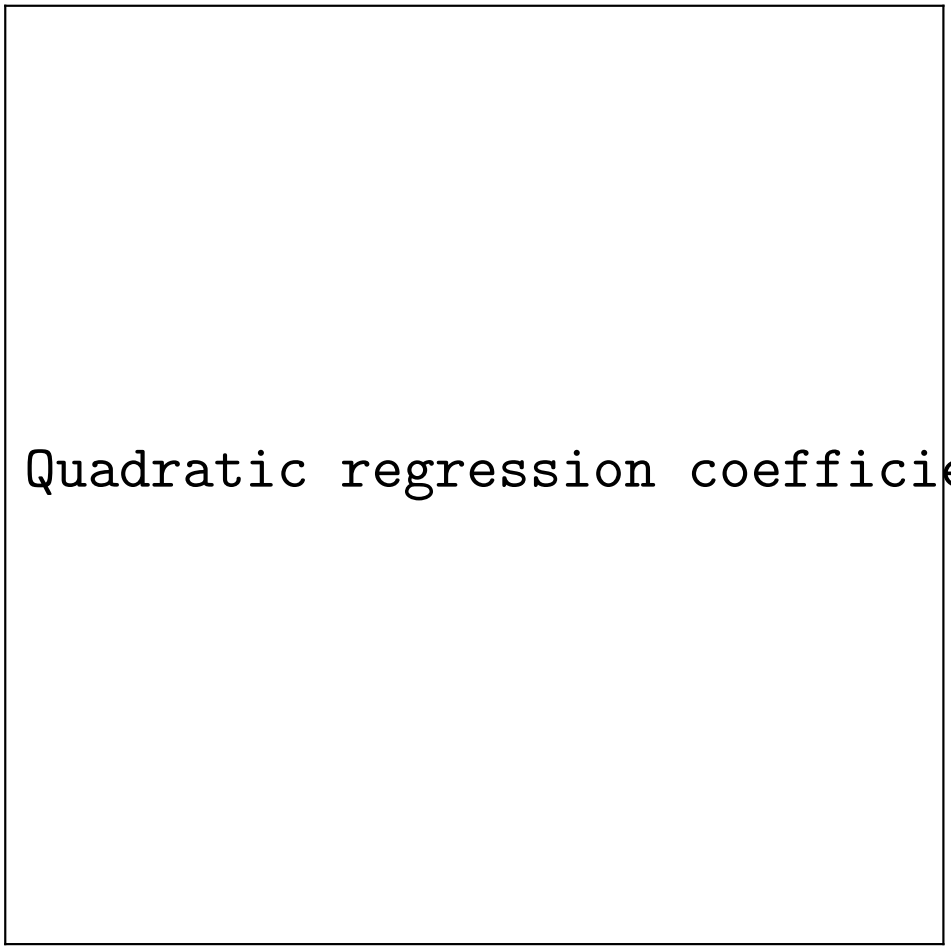


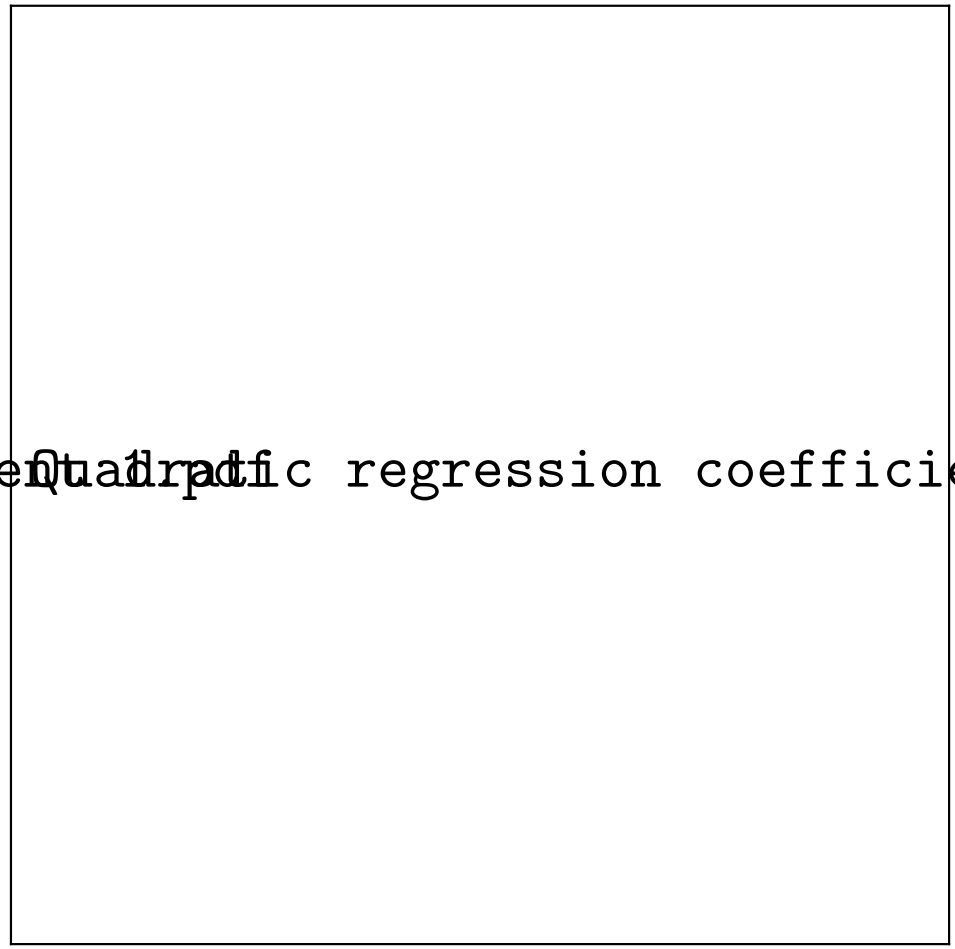
Main Estimation Results: Linear Form

Figure: The effect of autocorrelation in monetary shock on the consumption-rate elasticity



Main Estimation Results: Quadratic Form





The figure shows 3 coefficients β in the regressions (**??**) and (**??**). Standard errors are adjusted, heteroskedasticity and autocorrelation consistent. The confidence intervals corresponds to p$<$ 0.1, p$<$ 0.05, p$<$ 0.01.

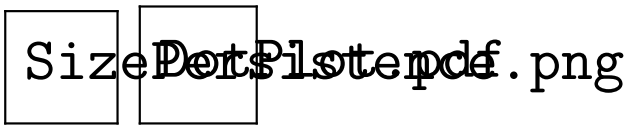
Results: Size-Persistence tradeoff. Table

Table: Regression coefficients on selected lags

	Dependent variable: Elasticity of consumption to $(r - r^*)$					
	$i = 3$		$i = 10$		$i = 20$	
	(1)	(2)	(3)	(4)	(5)	(6)
$L(\rho, i)$	-0.0708^{***}	-0.0800	-0.1223^{***}	0.1458	-0.0924^{**}	0.2633^{***}
	(0.0350)	(0.1612)	(0.0458)	(0.0980)	(0.0389)	(0.0405)
$L(\rho, i)^2$		0.11619		-0.3639^{**}		-0.4829^{***}
		(0.2176)		(0.1363)		(0.0612)
Constant	-0.0102^{**}	-0.0102^{**}	-0.0098	-0.010	-0.0113	-0.0117
	(0.0049)	(0.0049)	(0.0069)	(0.0069)	(0.0091)	(0.0092)
N	345	345	338	338	328	328
R^2	0.047	0.047	0.100	0.115	0.058	0.084
Adj R^2	0.044	0.041	0.109	0.130	0.055	0.079
Resid. SE	0.050	0.050	0.049	0.048	0.051	0.050
F Statistic	4.096^{**}	2.57^{*}	7.115^{***}	7.207^{***}	5.63^{**}	31.09^{***}

This table reports results of linear estimations of the effect of autocorrelations of monetary shocks on the elasticity of consumption to the rate for some of the selected lags. Heteroskedasticity and autocorrelation robust standard errors (Newey West, without prewhitening) in parenthesis. *p<0.1; **p<0.05; ***p<0.01.

Figure: Comparing ? (?) with the result



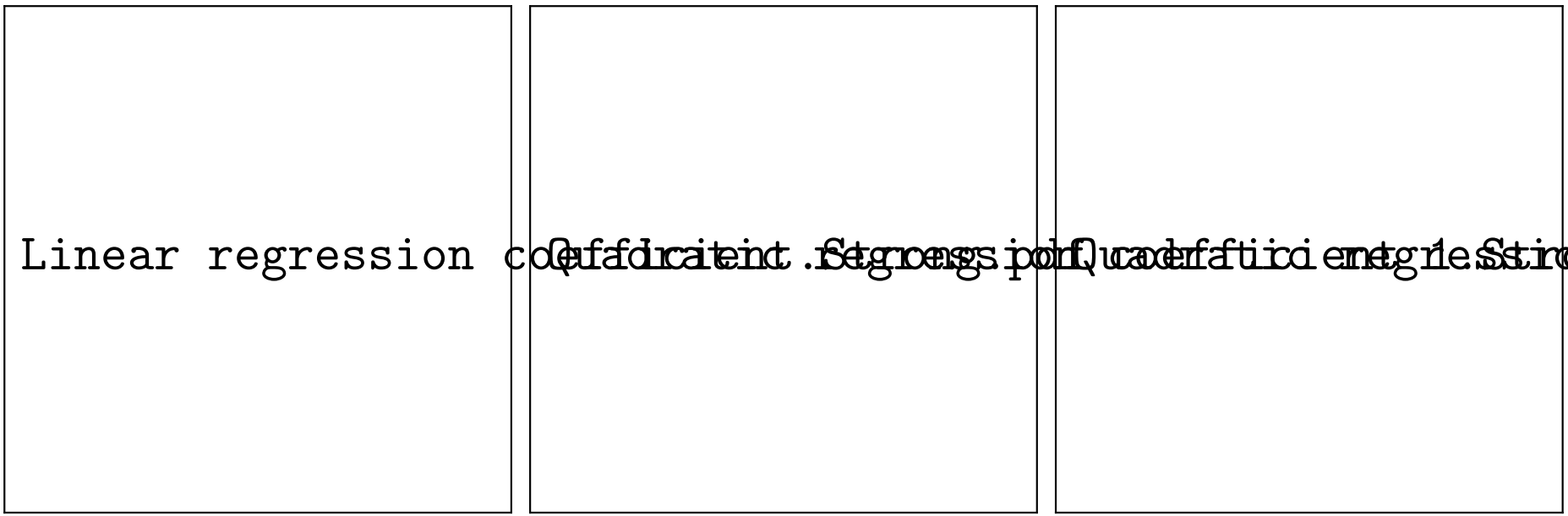
This plot shows the joint distribution of consumption to excess rate elasticity with 15th lag of autocorrelation of monetary shock. Standard errors are *not* autocorrelation and heteroskedasticity adjusted, $p<0.05$.

Robustness I. Granger causality test

Figure: Granger test for autocorrelation of monetary shock effect on consumption-deviation elasticity

Robustness II. Restricition to periods with strong instrument

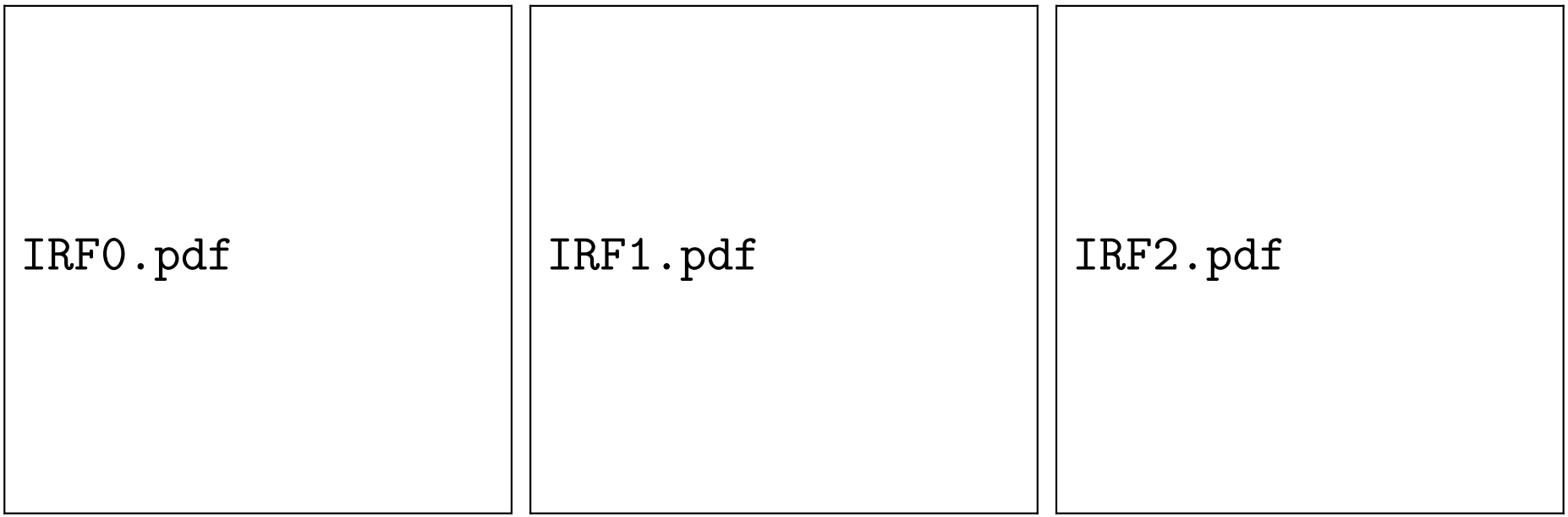
Figure: The effect of autocorrelation in monetary shock on the consumption-rate elasticity estimated for periods, when $\hat{R}$ is strong instrument



The coefficients β in the regression (**??**) and (**??**). Final sample is restricted to the area, where $\hat{R}$ is a strong instrument for elasticity of consumption estimation. Standard errors are adjusted, heteroskedasticity and autocorrelation consistent. The confidence intervals corresponds to p$<$ 0.1, p$<$ 0.05, p$<$ 0.01.

Robustness III. VAR estimation (Lag augmentation)

Figure: Impulse response function of VAR models corresponding to (**??**)-(**??**).



The confidence intervals are bootstrapped with 1000 runs. The confidence intervals corresponds to $p< 0.1$, $p< 0.05$, $p< 0.01$, the darker the region, the less is p value. Panel names stand for response function for impulse in stated variables in (**??**) and (**??**).

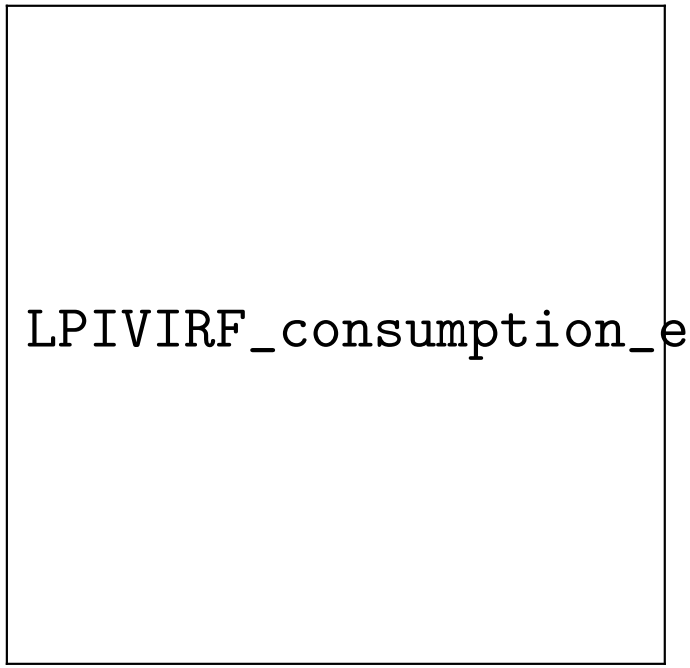
Conclusions

So, should we believe in HANK?

The evidence above suggests that, we should. At least we have found that consumption behaviour in size-persistent tradeoff corresponds to the HANK model.

Further work: Local Projection Estimation

Figure: Local Projection estimation



This figure shows Local projections estimated with AICc lag selection criterion, maximum number of lags is 30. Trend and quadratic trend included. Confidence intervals correspond to $p<0.9$.

Further work: unfinished part

Time Variation?
Time-varying coefficient Local Projection model estimation!

Figure: Example by ? (?)

Than we can estimate the (**??**)-(**??**) for each horizon of linear local projection.

Place for your suggestions and comments!

If you have any other suggestions/comments please write avlasov@nes.ru

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