

# Assessing the impact of conventional monetary policy on the capital-labor ratio in Brazil.

*Master thesis defense*

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# Summary

What are the effects of monetary policy on income distribution?

- ▶ Motivation:

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- ▶ Theoretical frameworks have been developed (eg. HANK models)
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- ▶ This work:
  - ▶ Investigates using monthly data from Brazil how the capital-labor ratio responds to conventional monetary shocks
  - ▶ Proposes an extension of [Uhlig, 1997] BVAR to time-varying parameters
- ▶ Key findings:
  - ▶ There is a significant negative effect of MP shocks in K/L ratio with effects that last for around a year
  - ▶ This relation changes over time, due to both changes in coefficients and also stochastic volatility
  - ▶ Findings are consistent with the hypothesis of an **income heterogeneity channel**

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- ▶ **IRF computation:** For each period, a different IRF is calculated using the respective estimated coefficients and volatility.

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Adding T to Uhlig's model

We can add time variation to the  $\alpha_t$  coefficients:

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And now we need two law of motions to describe the states:

$$\Omega_{t+1} = \lambda^{-1} \mathcal{U}(\Omega_t)' \Theta \mathcal{U}(\Omega_t), \text{ where } \Theta \sim \mathcal{B}_m(\nu + l/2, 1/2), \text{ and}$$

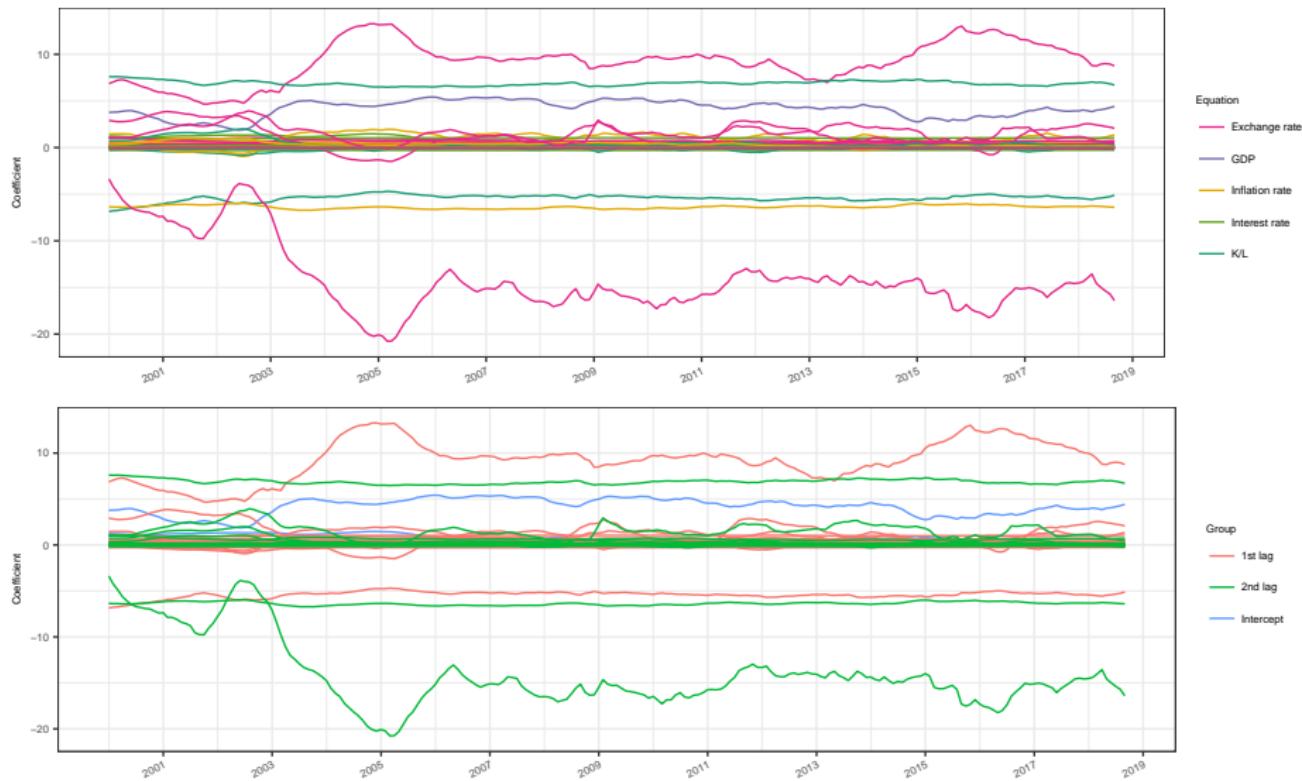
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# Results

Coefficients evolution across time

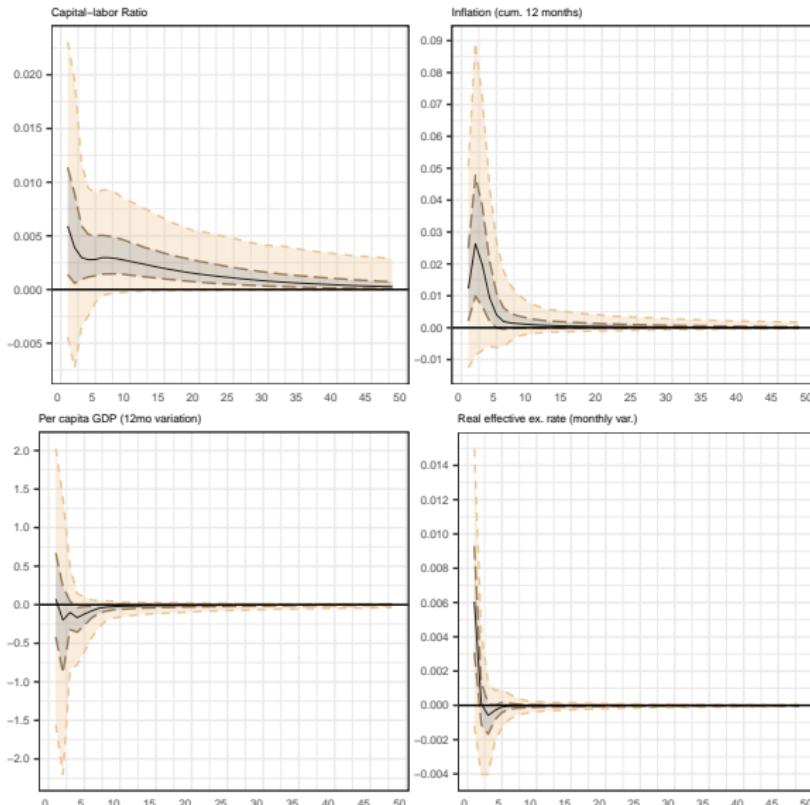
# Results

## Coefficients evolution across time



# Results

Effects from a unitary shock of the interest rate on the other variables - last period



# Results

Effects from a unitary s.d. shock of the interest rate on  $K/L$  and Inflation - selected periods based on changes in the CB or the Min. of Finance

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Effects from a unitary s.d. shock of the interest rate on the capital-income ratio - all periods

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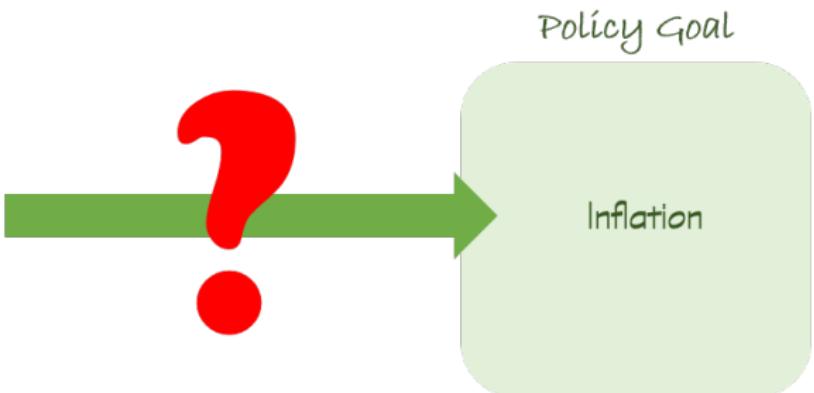
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- ▶ How to find the mechanism?
- ▶ **Shrinkage** methods such as the one described in [Bitto and Frühwirth-Schnatter, 2016] could be used in order to improve estimates.

# Motivation

How the Central Bank affects the economy?



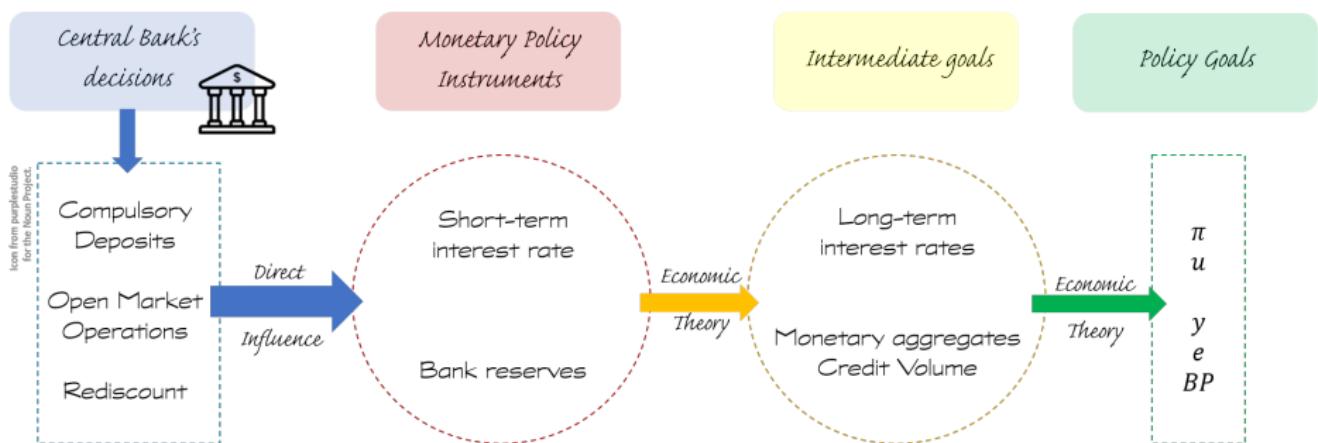
Central Bank



Icon from purplestudio  
for the Noun Project.

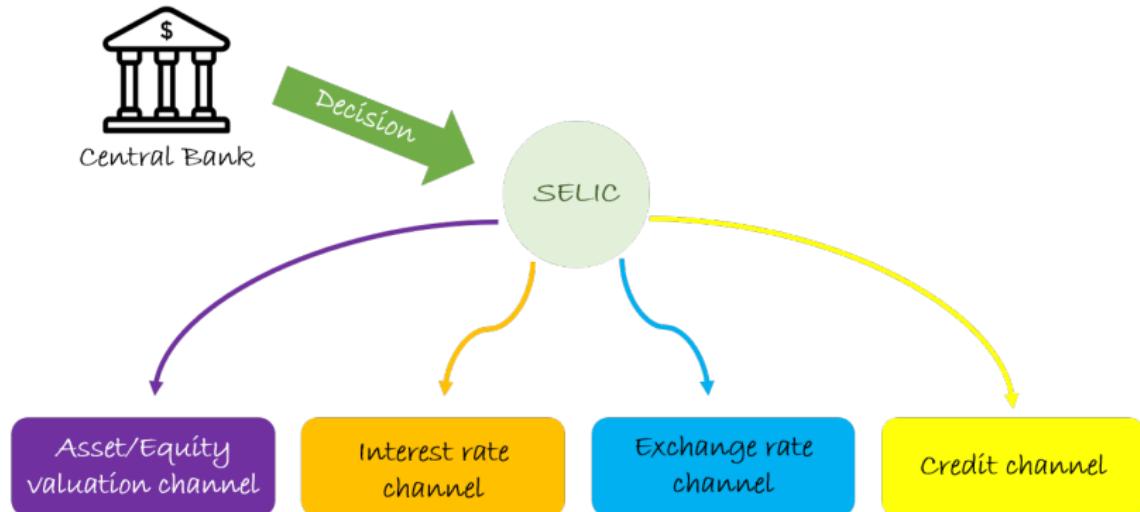
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# Monetary Policy transmission channels

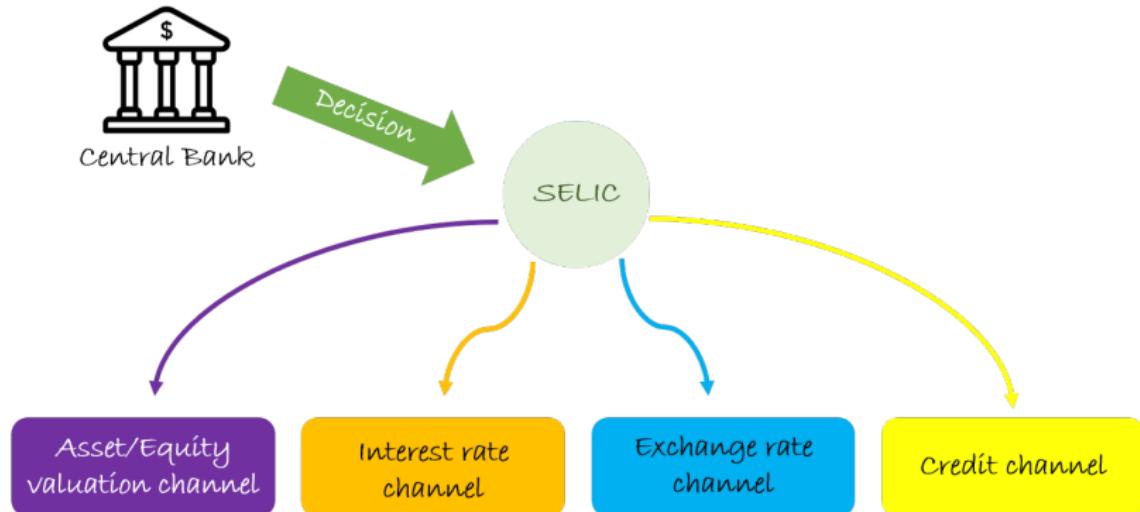
How the MP decisions reach the economic aggregates



Adapted from Mishkin (1996).

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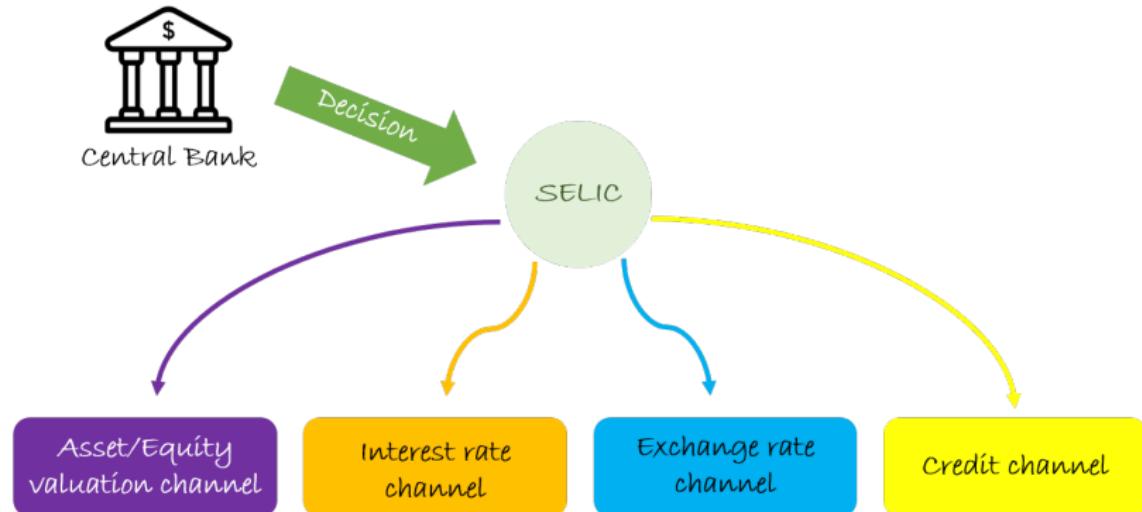


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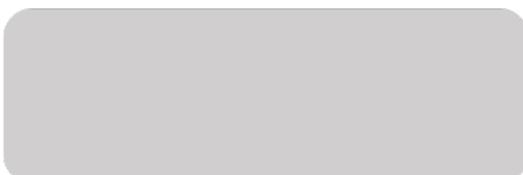
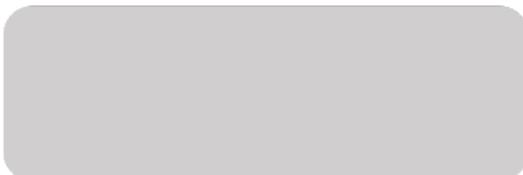
- ▶ Is it reasonable to assume that the MP effects will be **homogeneous** among households?
- ▶ What if the overall effect of monetary policy is conditional to the degree of **heterogeneity** among households?

# Outline

*Introduction: the  
heterogeneous  
effects of MP*



You are here!



# Outline

*Introduction: the heterogeneous effects of MP*

*The redistribution channels of MP and empirical results*

"Economics background"



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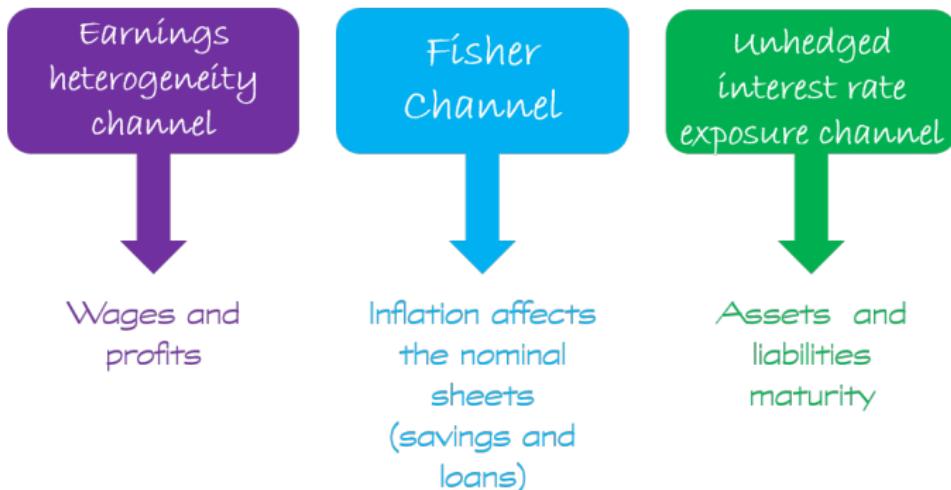
# Motivation

## Aggregation and heterogeneity

“Aggregation would not matter if we could be sure that the marginal propensities to spend from wealth were the same for creditors and debtors. (...) There are indeed reasons for expecting or at least for suspecting, just that. **The population is not distributed between debtors and creditors randomly.** Debtors have borrowed for good reasons, most of which indicate a high marginal propensity to spend from wealth of from current income or from any liquid resources they can command.”  
[Tobin, 1982]

# Redistributive channels of monetary policy

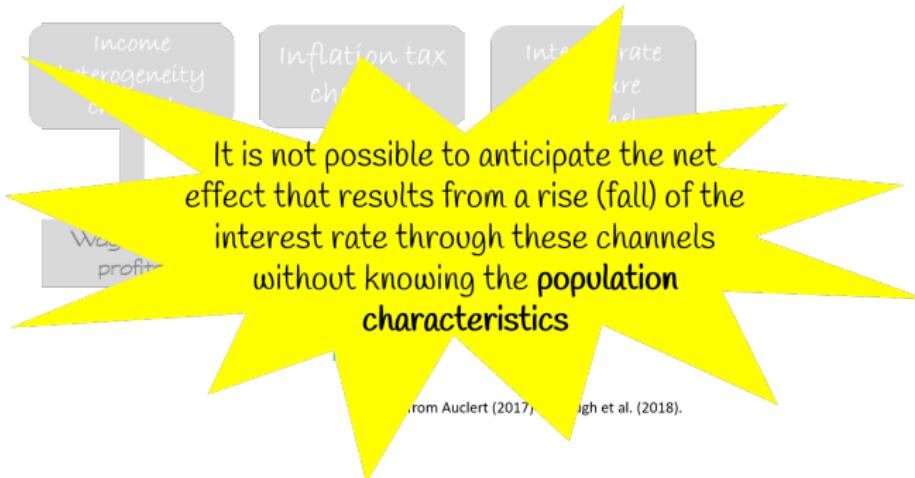
How the MP decisions reach the economic aggregates **agents** and affect their income and wealth



Adapted from Auclert (2017) and Pugh et al. (2018).

# Redistributive channels of monetary policy

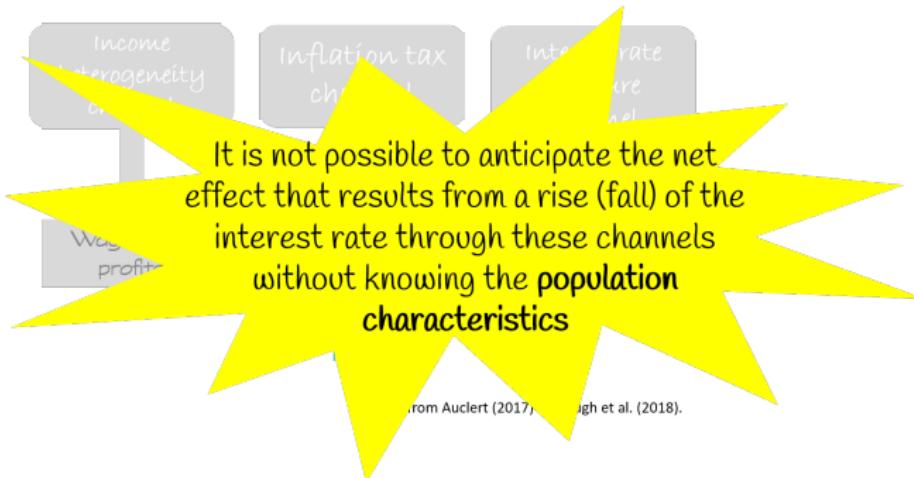
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# Redistributive channels of monetary policy

How the MP decisions reach the economic aggregates **agents** and affect their income and wealth



- ▶ The net effects of the MP transmission through these channels are **uncertain** and depend on the characteristics of a particular economy.
- ▶ Theory by itself **cannot assess** the direction or global magnitude of the MP on income and wealth distribution when we consider all channels together - **empirical studies are needed** [Pugh et al., 2018].

# Redistributive channels of monetary policy

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A common characteristic between the three redistributive channels shown before is that the **income composition** matters: wages, financial assets, savings, loans, etc.

# Redistributive channels of monetary policy

## Income heterogeneity



Cartoon adapted from Sarah's Scribbles  
(<https://www.facebook.com/pg/DoodleTimeSarah>).

# Redistributive channels of monetary policy

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Less Income



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# Redistributive channels of monetary policy

## Income heterogeneity

Less Income



Depends from  
gov. transfers



Will be mostly  
unaffected by  
changes in  
Interest rates

Income from  
labor  
(cat sitter)



Interest rate  
affect  
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More Income

Income from  
labor + capital

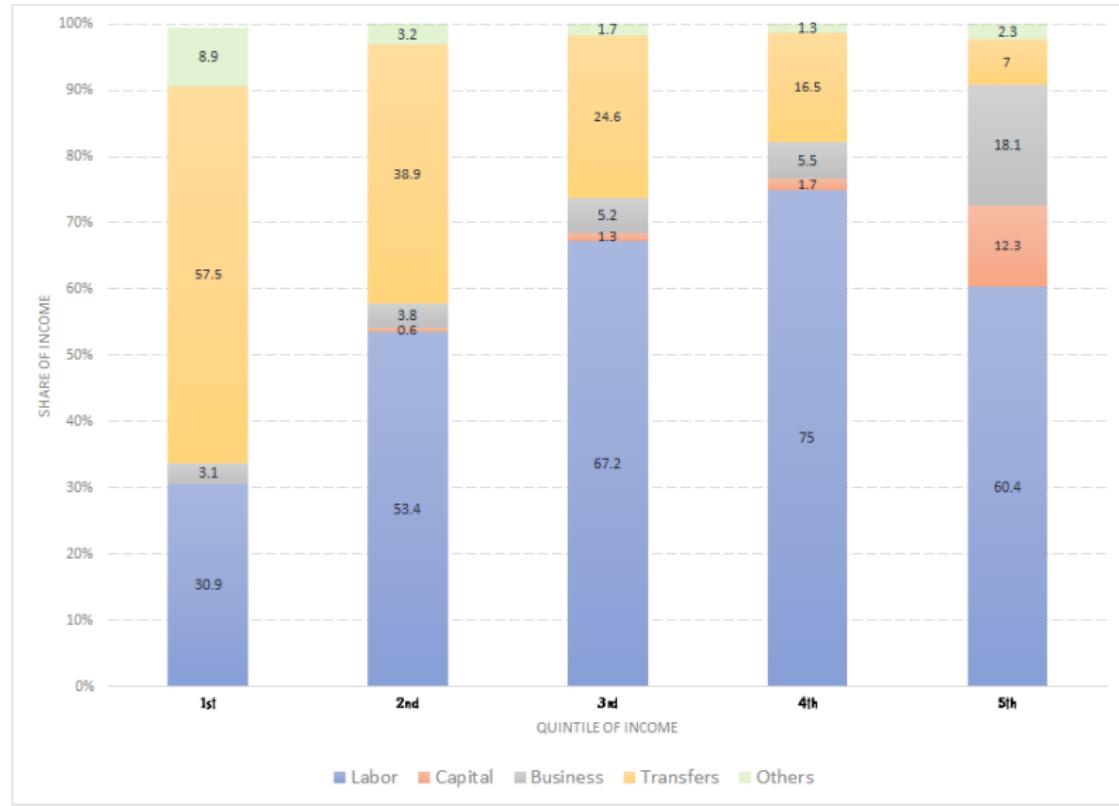


The portion of the  
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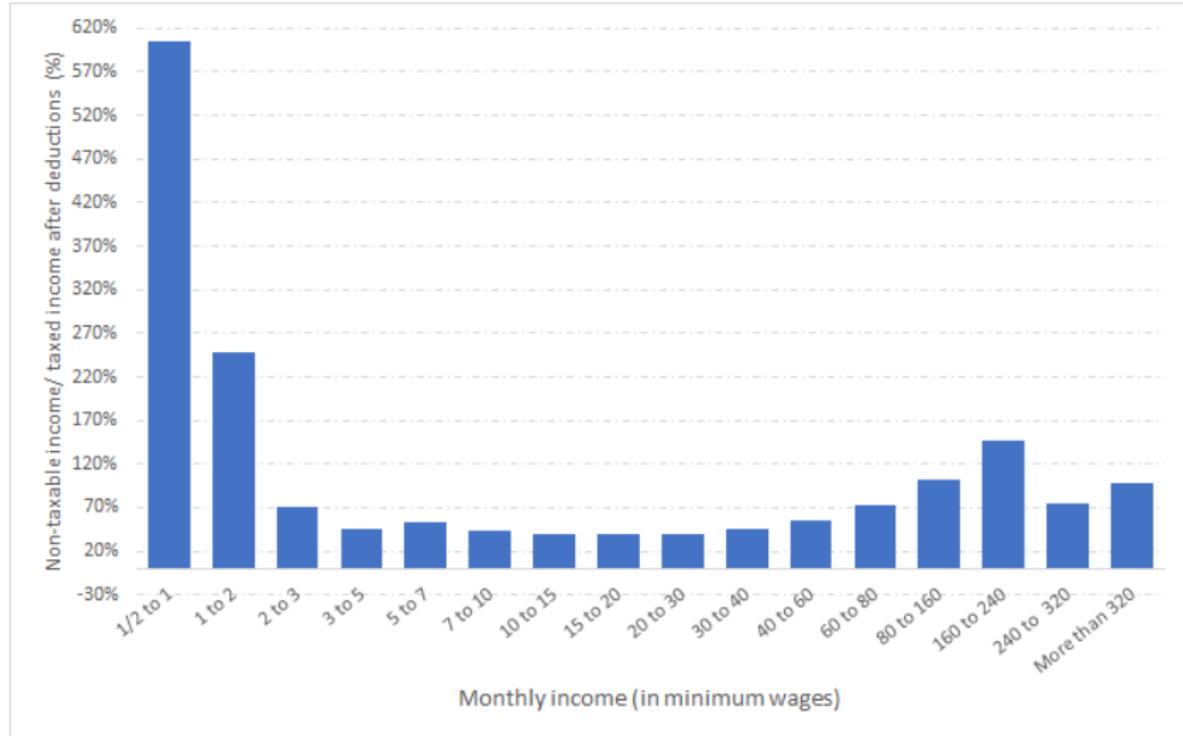
## Income heterogeneity



**Figure:** Income source as a share of household income. United States, 2013.

# Redistributive channels of monetary policy

## Income heterogeneity



**Figure:** Non-taxable income as proportion of the taxed income accordingly to groups of total declared income, Brazil, 2016.

# What if we want to make an empirical study for Brazil?

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- ▶ In order to capture the relationship between the interest rate changes and some income distribution variable, we are going to need at least **quarterly data**.

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- ▶  $K/L$  is a measure that represents the ***functional distribution of income*** between two factors: labor and capital;
  - ▶ It is the quotient between the share of capital income by the share of labor income;
- ▶ If these two factors are not evenly distributed among the population then ***changes in  $K/L$  represent redistribution effects.***

# Research proposal

## Our quest

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Side quest:

1. To **extend** [Uhlig, 1997] BVAR to a **TVP-VAR** model.

# Empirical model

## Adding T to Uhlig's model

We can add time variation to the  $\alpha_t$  coefficients:

$$y_t = Z_t \alpha_t + \epsilon_t, \quad (2)$$

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- ▶ We cannot observe  $\alpha_t$  directly (**latent variable**);
- ▶ If  $\Omega_t^{-1}$  was deterministic, then we could use the Kalman filter;
  - ▶ Since it is not the case, we have an **high dimensional integral that cannot be solved in closed-formula**.

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## Problem

We are going to need a method to estimate the parameters!

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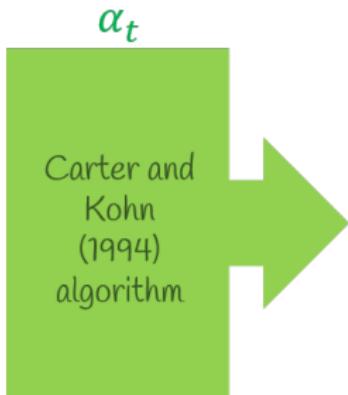
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- ▶ Even when the **posterior is unknown**, we can resort to **MCMC methods** to obtain draws of the posterior to make inference;
- ▶ We are able to make inference using an **entire posterior density**.

### Proposal

To use [Windle and Carvalho, 2014]'s propositions in a Gibbs sampler algorithm combined with [Carter and Kohn, 1994] and a conjugate prior.

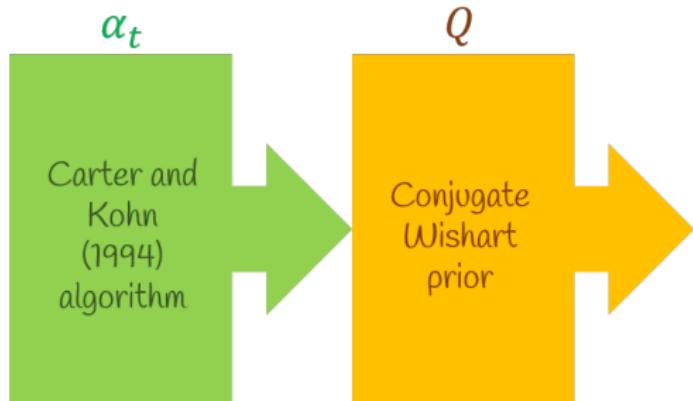
# Estimating Uhlig's extended model

Gibbs sampler scheme



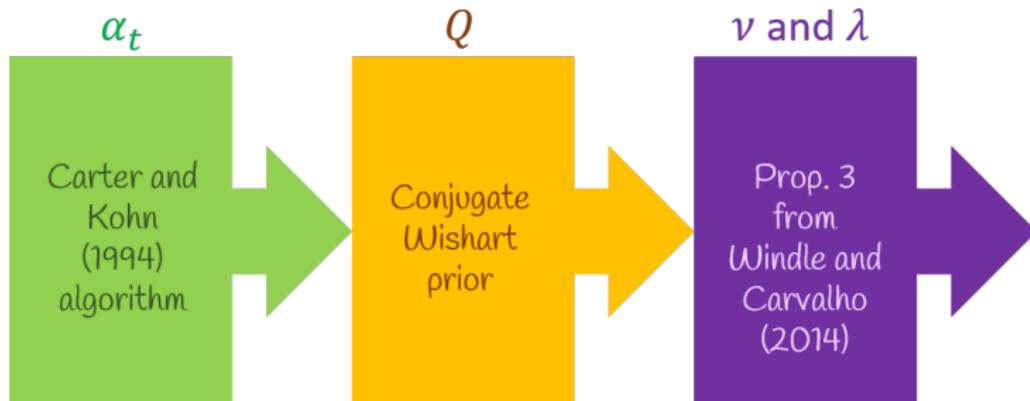
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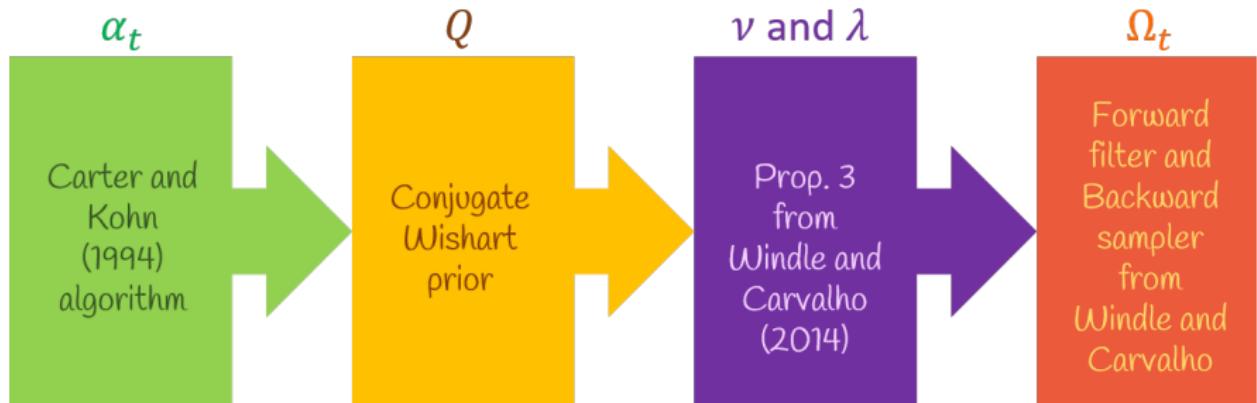
# Estimating Uhlig's extended model

## Gibbs sampler scheme



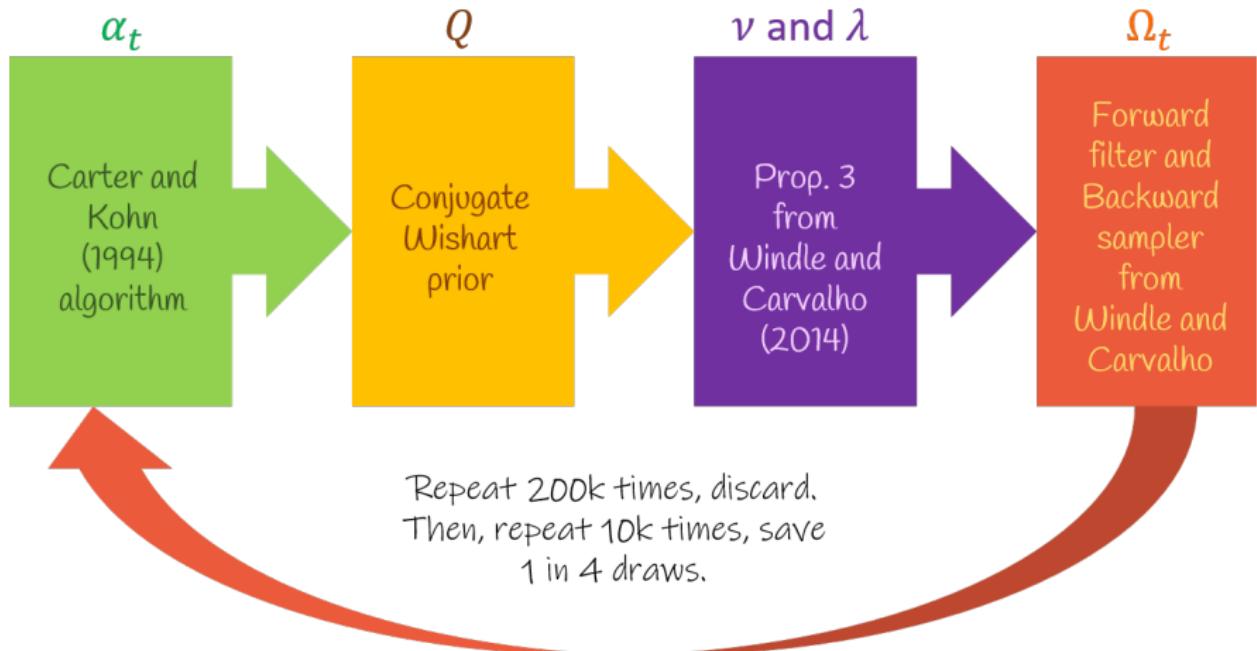
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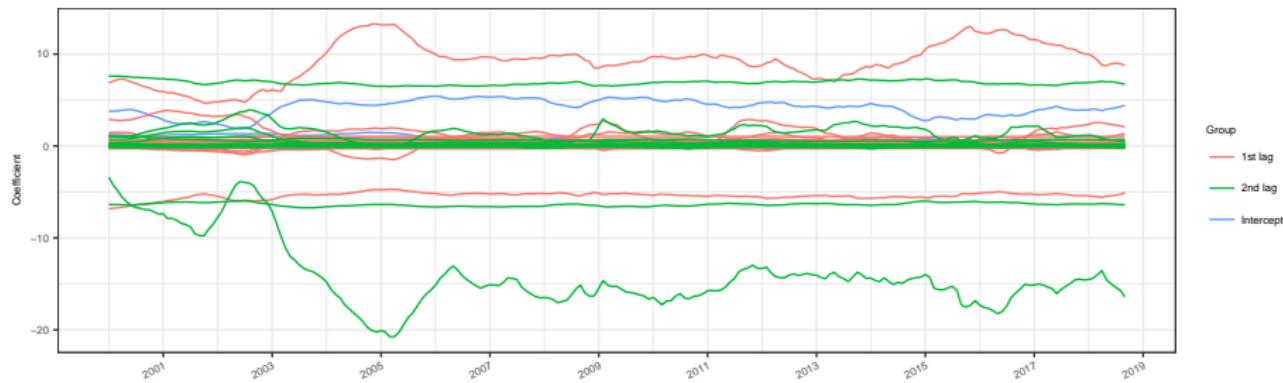
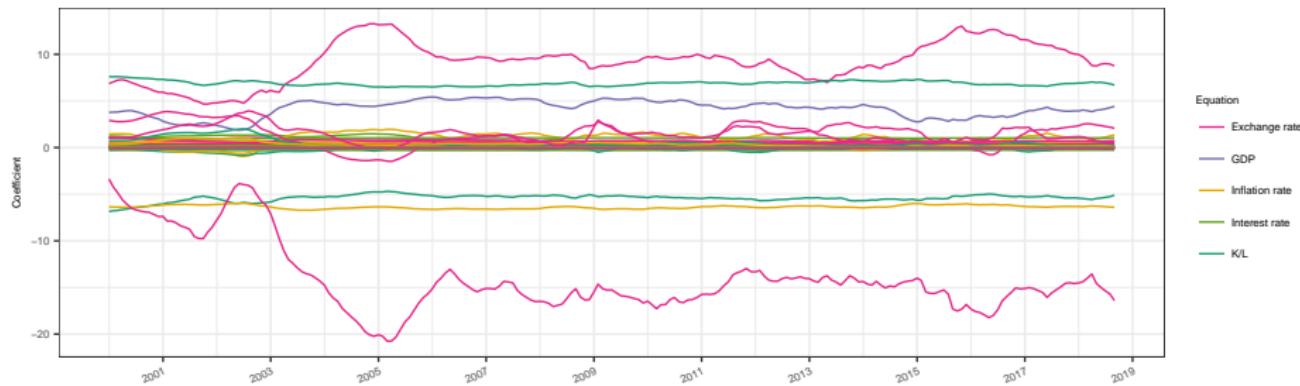
- ▶ **IRF computation:** For each period, a different IRF is calculated using the respective estimated coefficients and volatility.

# Results

Coefficients evolution across time

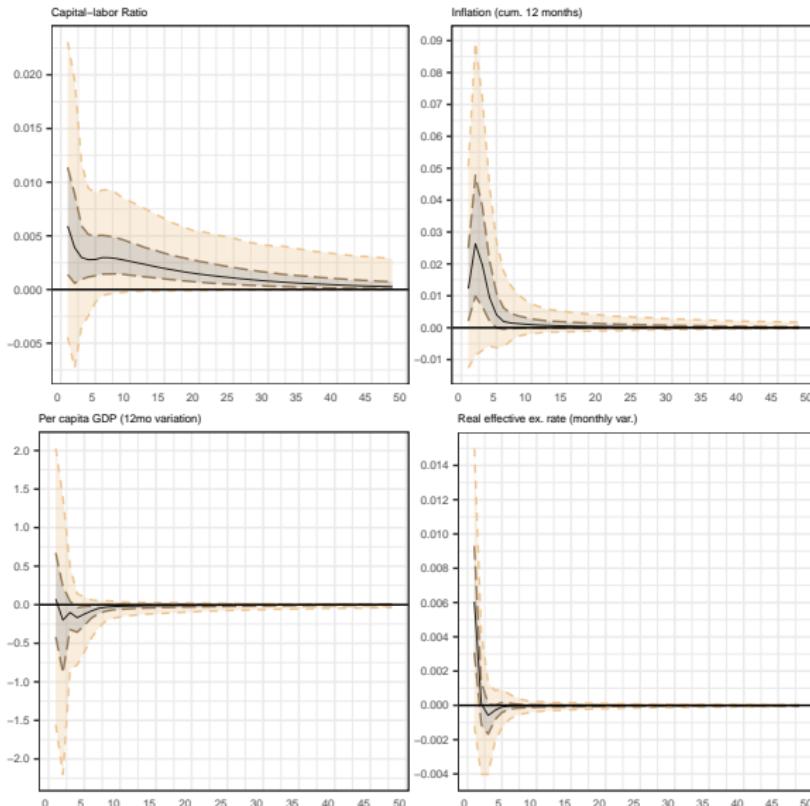
# Results

## Coefficients evolution across time



# Results

Effects from a unitary shock of the interest rate on the other variables - last period



# Results

Effects from a unitary s.d. shock of the interest rate on  $K/L$  and Inflation - selected periods based on changes in the CB or the Min. of Finance

# Results

Effects from a unitary s.d. shock of the interest rate on the capital-income ratio - all periods

# Wrapping up

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- ▶ This **relationship** was **not stable** during the inflation-target period - it became weaker and non-significant after 2010;
  - ▶ Although there is no evidence of large drifts in the coefficients, there is sufficient noise in the estimated variance to suggest the presence of stochastic volatility.
- ▶ Our findings are compatible with the hypothesis of the **income heterogeneity channel**, although it is not possible to discard completely the existence of a **interest exposure channel** effect.

# Further developments

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- ▶ Estimate a simpler model using data from the **national accounts** (IBGE, quarterly) - robustness check;
- ▶ **Shrinkage** methods such as the one described in [Bitto and Frühwirth-Schnatter, 2016] could be used in order to improve our estimates.

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# Assessing the impact of conventional monetary policy on the capital-labor ratio in Brazil.

*Thank you!*

<http://aishameriane.github.io>



**Candidate:** Aishameriane Schmidt  
**Advisor:** Prof. Dr. Guilherme Valle Moura

https://aishameriane.github.io

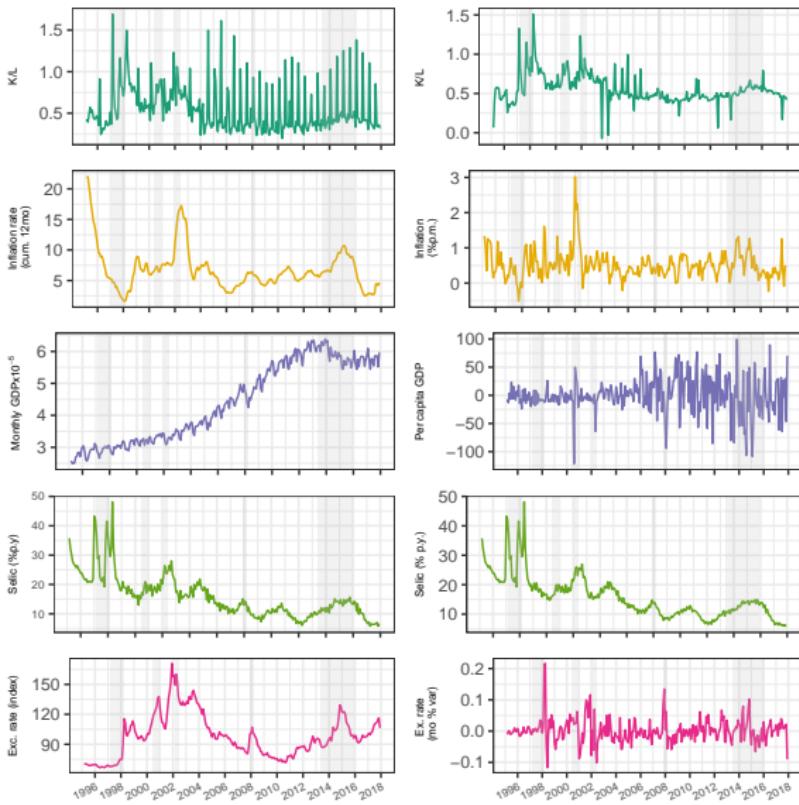
Programa de Pós-Graduação em Economia - PPGEco/UFSC.



**UFSC**

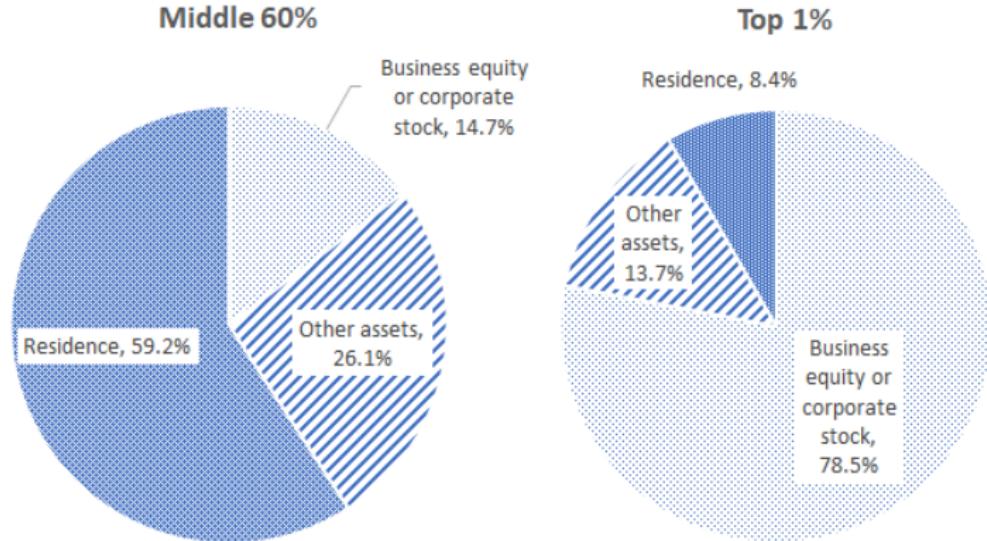
# Extras

## Series used in the VAR



# Redistributive channels of monetary policy

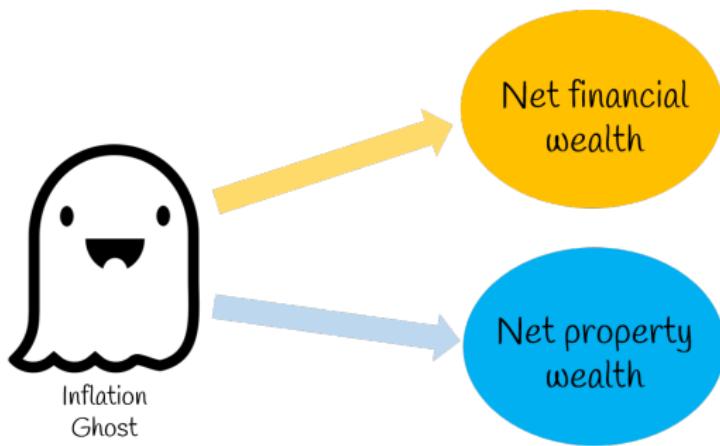
## Wealth heterogeneity



**Figure:** Wealth composition for different household groups in the USA, 2001.

# Redistributive channels of monetary policy

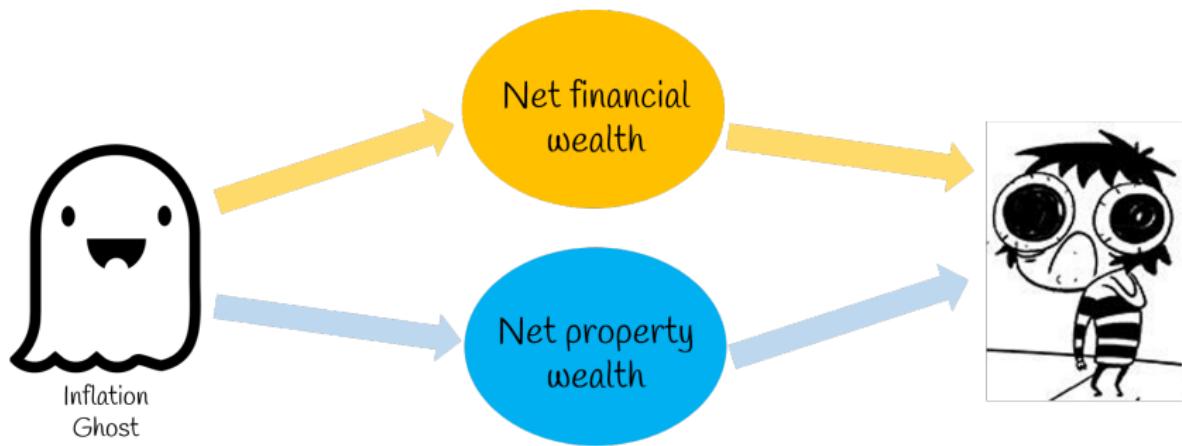
## Fisher (or inflation) channel



Cartoon adapted from Sarah's Scribbles (<https://www.facebook.com/pg/DoodleTimeSarah>) and Ghost by Oksana Latysheva from the Noun Project.

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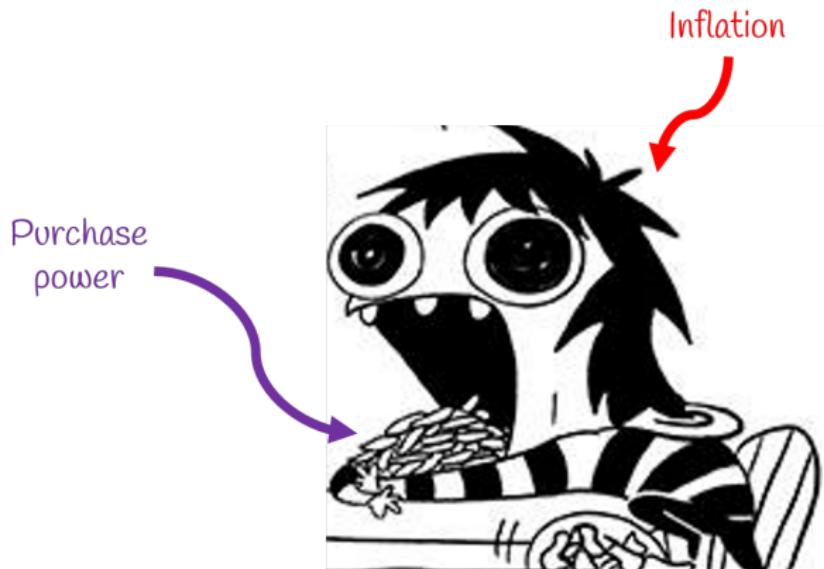
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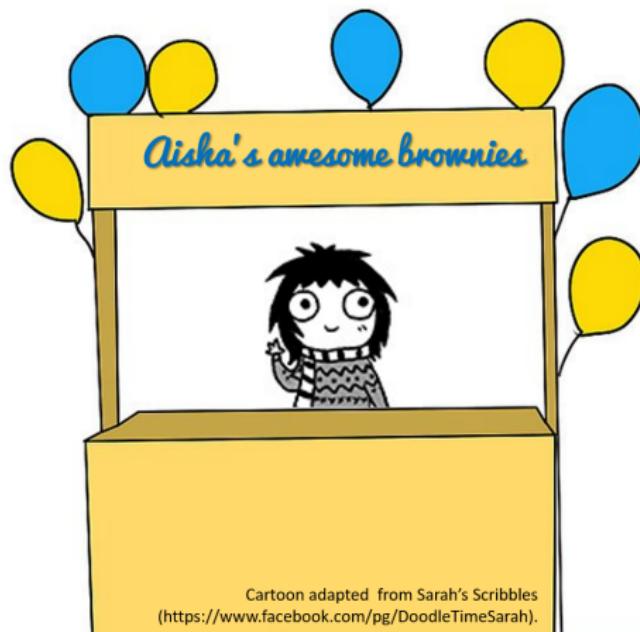
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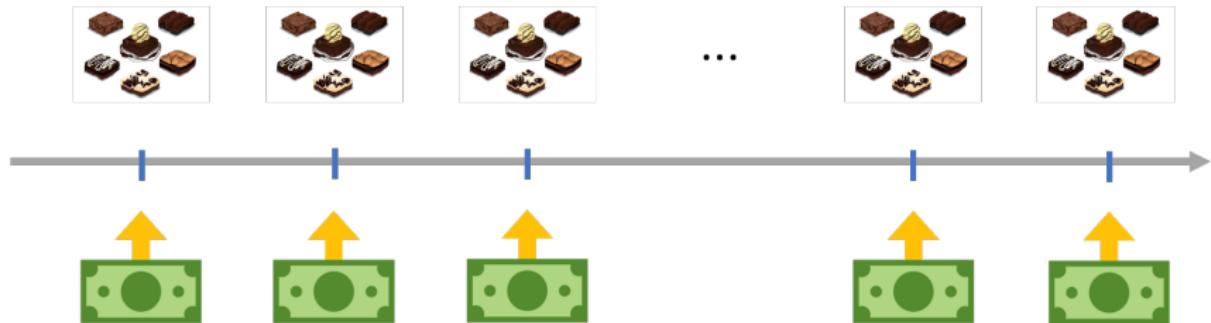
## Interest rate exposure channel



**Figure:** Aisha's plan B if the PhD applications go wrong.

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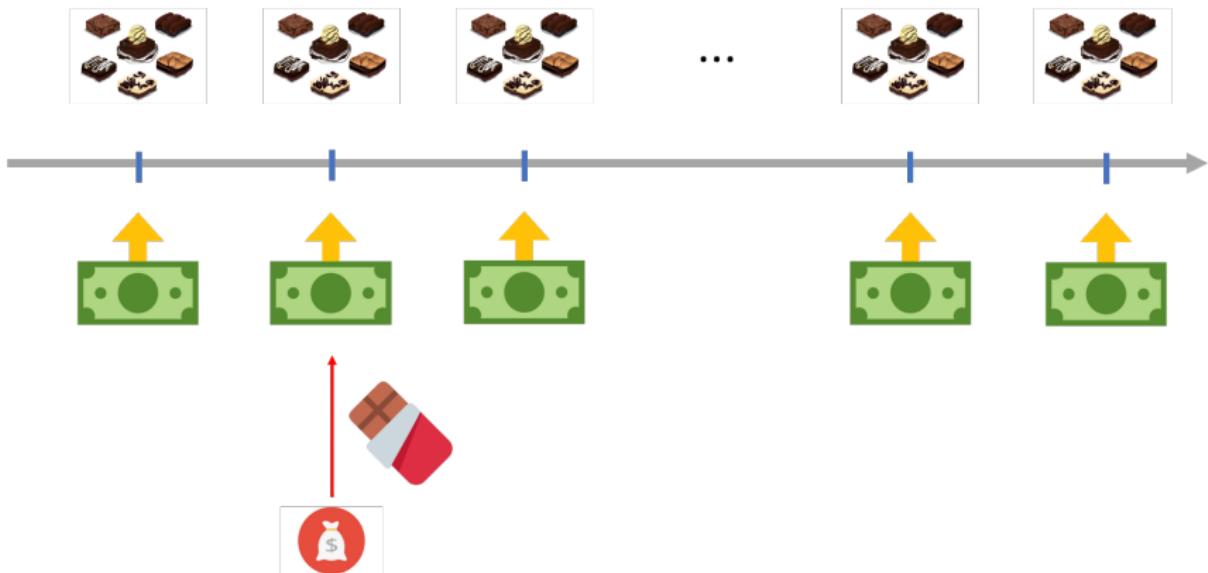
## Interest rate exposure channel



**Figure:** Payments for goods made on the same day of the inputs purchase.

# Redistributive channels of monetary policy

## Interest rate exposure channel



**Figure:** A shock on the Belgian chocolate price will be covered by the daily payment.

# Redistributive channels of monetary policy

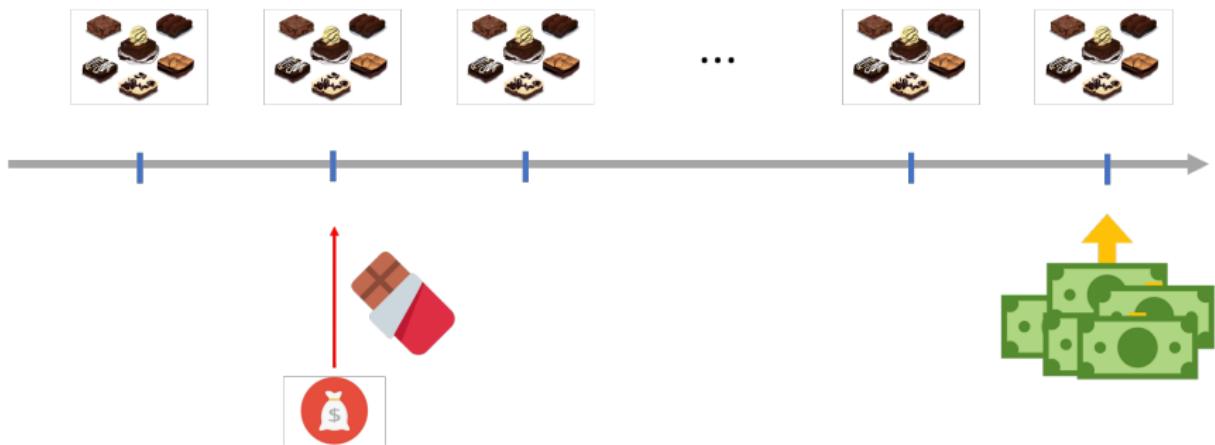
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**Figure:** Payments for goods made by the end of the month - the contract includes raises in the inputs.

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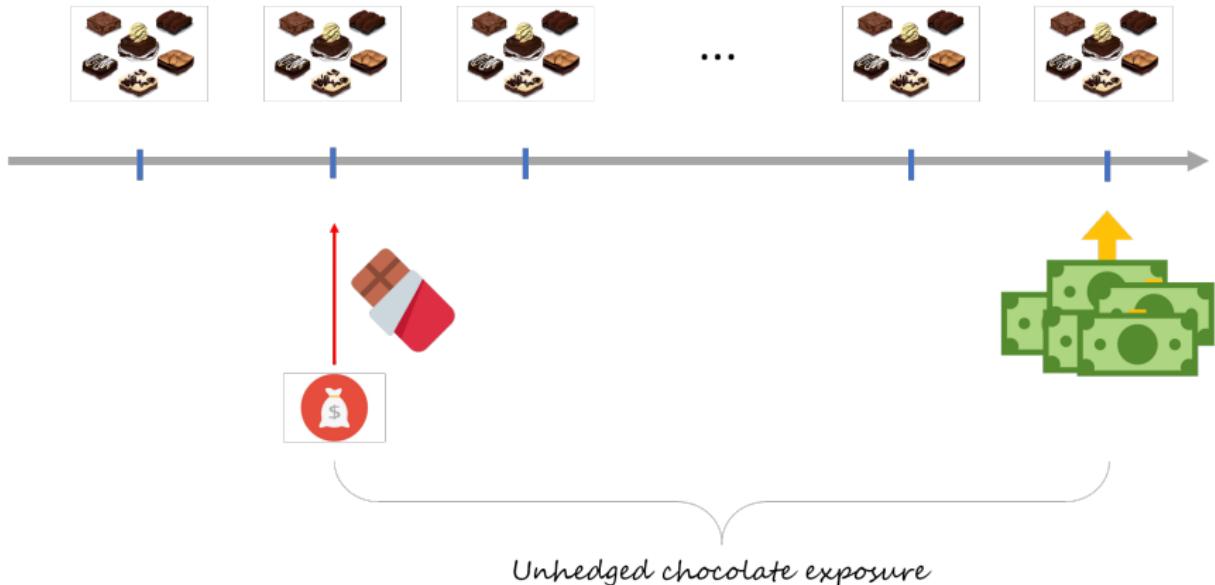
## Interest rate exposure channel



**Figure:** A shock on the Belgian chocolate price will be compensated only by the end of the month, and that might be too late.

# Redistributive channels of monetary policy

## Interest rate exposure channel



**Figure:** The time between the input purchase and the payment for the brownies is the period of the *Unhedged Chocolate Exposure*.

# After defense

Join me to celebrate (or not)

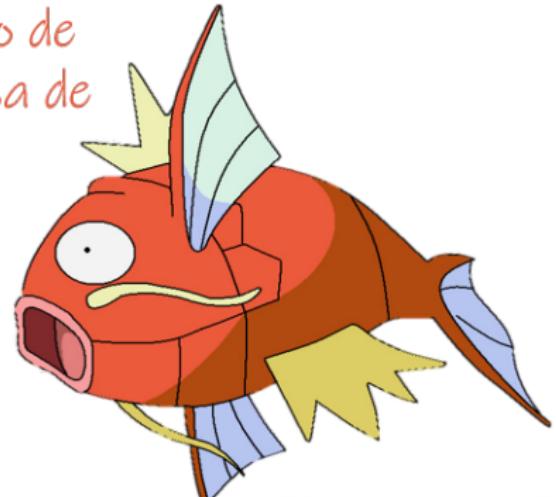
Comemoração ou afogamento de  
mágoas após a n-ésima defesa de  
mestrado da Aisha (n=1)

Local: O Viking hamburguer e chopp (Lauro Linhares, próximo à Madre Benvenuta, no Posto de Gasolina da Vovó)

Dia: 15/03/2019 (sexta-feira)

Horário: 20h

\* Para não estragar o evento, é proibido perguntar “E agora, vai fazer o quê?”, “Como vão os applications?”, “Vai publicar em algum lugar?”, “Se inscreveu no doutorado?” e similares :D



***“Everything evolves”***

**Figure:** We are going to celebrate or join Aisha in misery tonight (8 pm) at “O Viking Hamburguer e Chopp”, at Lauro Linhares Street, 1619 (it is in a gas station). It is forbidden to ask her about PhD applications unless you want to talk about making a funded offer. :-)