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Moving Closer or Drifting Apart: Distributional Effects of Monetary Policy

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Abstract

Our paper picks up the current controversial debate about increasing (income) inequality due to recent monetary policy measures in major advanced economies. We use a VAR framework identified with sign restrictions to figure out how income inequality related measures react to monetary policy in six different advanced economies. These countries differ by their absolute income inequality as well as their redistribution. We choose the U.S., Canada and South Korea as countries with very little redistribution and Sweden, the Czech Republic and Hungary as countries with relatively high redistribution. While all economies experience an increase in Gini coefficients of gross income in the presence of an expansionary monetary policy shock, only the U.S., Canada and South Korea also show a significant response in Gini coefficient of net income. To figure out how the transmission of monetary policy to income inequality works we pick up the two major channels dominant in the literature: The employment channel and the income composition channel. The latter is analyzed by data from national accounts concerning two different kinds of income households receive: Labor related income and capital payments, both net. While we find that capital owners profit disproportionately in the less redistributing countries, we observe a more even reaction in both income types. This indicates that the harmful effects of expansionary monetary policy on the market income distribution are mitigated if the degree of redistribution is high.

Keywords: Income Inequality, Factor Income Distribution, Monetary Policy, VAR, Sign-Restrictions

JEL classification: D31, D33, E24, E25, E52, E64

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1 Introduction

"All economic policy-makers have some distributional impact as a result of the measures they introduce - yet until relatively recently, such consequences have been largely ignored in the theory and practice of monetary policy." Yves Mersch (ECB), 2014

The financial crisis has set the limit of conventional monetary policy measures for the majority of the advanced economies. To stabilize financial markets and stimulate the economy major central banks around the world steadily lowered their policy rates up to the zero lower bound (ZLB). To ensure capacity for actions the central banks imposed unconventional measures including i.a. large-scale asset purchase programs and forward guidance. As a consequence, equity and housing prices increased while, at the same time, interest rates and returns on savings remained at an all-time low. In public, this constellation strengthened the perception of rising inequality arguing that such measures benefit already wealthy capital owners disproportionately. The public arousal forces policy makers and academia to discuss the distributional consequences of monetary policy.

However, no central bank pursues equality per mandate.¹ Nonetheless, economic key indicators that are within the scope of central banks like inflation and growth have distributional effects themselves. For example, Doepke & Schneider (2006), Albanesi (2007) and Adam & Zhu (2016) find that unexpected inflation coincides with higher level of inequality. The analyses by Romer & Romer (1999) indicate a positive relation between inequality and both, average inflation and variability of nominal GDP growth. Thus, every policy measure that addresses one or both of the key indicators will have inevitably distributive effects.

Still, policy makers might have an intrinsic interest in moderate levels of inequality: Areosa & Areosa (2016), Auclert (2016), and O'Farrell et al. (2016) ascertain that

¹Also because it is troublesome to measure a (socially accepted) "natural level of inequality". Still, some attempts were made. See for example Rodriguez et al. (2002) or Heer & Maussner (2009). Mankiw (2015) describes anecdotally, why some level of inequality is necessary for prosperity.

higher levels of inequality coincide with less stimulating power of monetary policy. However, there are several mechanisms through which monetary policy may affect the distribution of income and wealth. Since we are interested in the link between monetary policy and income inequality, we limit our analyses to the following channels:²

The *employment channel*: Labor income is the major earnings source for the vast majority of households. However, high-skilled and low-skilled households respond differently to monetary policy induced fluctuation on the labor market. If low-skilled households are more likely to be affected by unemployment in an economic downturn, a monetary stimulus benefits those households disproportionately and alleviates an increase in income inequality.³

The *income composition channel*: Households differ in terms of their primary incomes. If monetary policy benefits capital income more than labor income, e.g. through a boost in stock prices as it has been caused by quantitative easing (QE), income inequality will increase because capital income receivers are primarily high-income households.

Neither is the transmission of monetary policy to inequality unambiguous, nor the findings in the literature. Mumtaz & Theophilopoulou (2015) and Coibion et al. (2012) discover that contractionary monetary policy shocks increase inequality in earnings, income, and consumption. In their analysis for the U.S., Coibion et al. (2012) draw a number of conclusions. In the aftermath of the monetary shock, wage earnings for those in the upper end recover notably faster than for those at the bottom of the wage distribution. The total income effect is smaller because low-income households disproportionately rely on transfers which in turn react countercyclical. Lansing & Markiewicz (2016) and Coibion et al. (2012) state that the distributional effects for the U.S. were mitigated by governmental redistribution.⁴ In contrast,

²For a more detailed overview concerning the remaining channels, see Coibion et al. (2012).

³Coibion et al. (2012) refer to this channel as the *earnings heterogeneity channel*.

⁴In addition, redistribution can be pro-growth given the positive effects of lower inequality on growth, as Ostry et al. (2014) show.

Davtyan (2016) finds evidence that contractionary monetary policy shocks are associated with lower income dispersion in the long-run in the U.S.

Primarily, unconventional policy measures are suspected to be one of the main drivers of increasing inequality in recent years. The argument is that extremely loose monetary policy disproportionately benefits asset holders, because a broad variety of assets grow in value from large-scale asset purchasing programs. Overall, the contribution of unconventional monetary policy measures to increasing inequality is not clear cut and respective research limited.

Mumtaz & Theophilopoulou (2015) gauge an additional effect on inequality from unconventional measures taken by the Bank of England in the aftermath of the financial crisis. Adam & Tzamourani (2016) find that the ECB's 2012 announced Outright Monetary Transactions (OMT) program influenced market prices such that the top 5% wealth group benefited disproportionately.⁵ Domanski et al. (2016) find that wealth inequality in advanced economies has risen since the financial crisis. They identify surging equity prices as the key driver. The recovery in house prices in the aftermath of the subprime crisis has offset the effect only partially.⁶

Looking at the distributional consequences of unconventional monetary policy in the aftermath of the great financial crisis disregards the distributional consequences idleness would have. For example, Bivens (2015) claims that the stimulating effect of the Fed's large-scale asset purchasing program (LSAP) on the labor market and housing prices prevented even larger distributional consequences.

We want to shed more light on the transmission channels of monetary policy on inequality. With focus on the income composition and employment channel, we follow the procedure by Bernanke & Gertler (1995) and analyze the potential

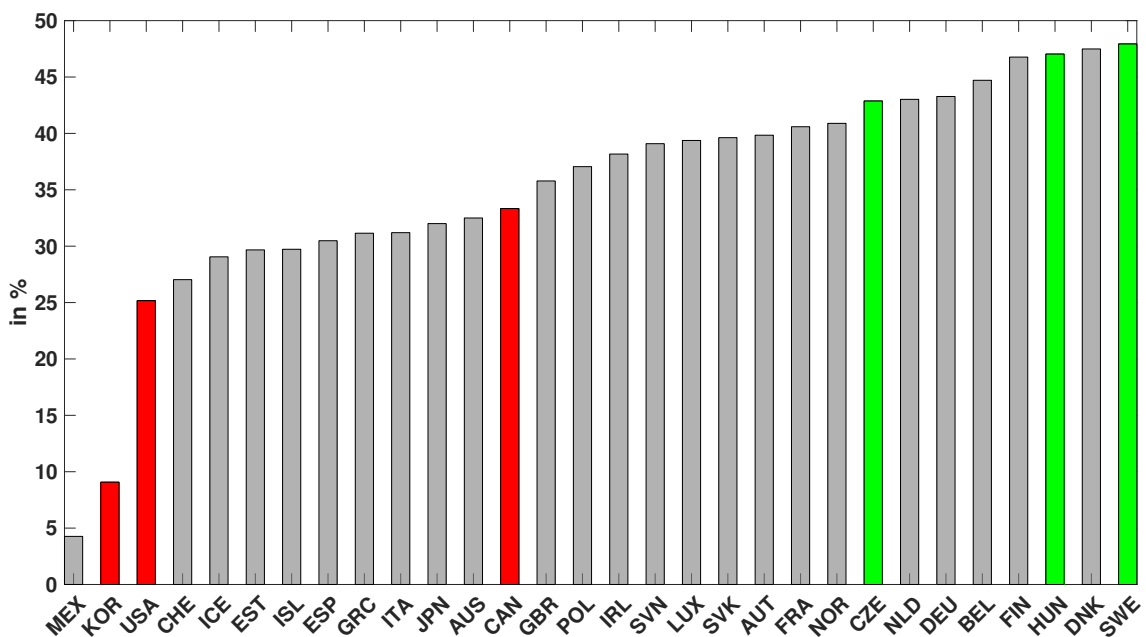
⁵The wealth-richest 5% experienced an 3.5% increase in capital gains while the other groups (lowest 20%, 20-70% and 70-95%) experienced an increase >1%).

⁶That this finding is not universally valid shows e.g. the German case, where Demary & Niehues (2015) ascertain no evidence for an increase in inequality due to unconventional monetary policy by the ECB, precisely because young, indebted households benefit disproportionately from an overall decrease in interest rates. Adam & Tzamourani (2016) also find controversial results for the euro area.

mechanisms that drive the Gini measures after an expansionary monetary policy shock. To gain insight into the income composition channel, we substitute the Gini measures successively by labor income, capital income, and the capital-wage-ratio. For the employment channel, we substitute the Gini by the number of employed people.

Our sample comprises countries that a) have an independent and decentralized central bank with no currency peg, and b) differ in their scope of redistribution. Thus, our analysis relies on the U.S., Canada, South Korea, Sweden, the Czech Republic, and Hungary. To incorporate redistributive effects, we analyze the impulse responses of both, the gross Gini and net Gini, i.e. the distribution of income after taxes and transfers.

Figure 1: Relative Redistribution



Note: Relative redistribution is defined as the difference between gross and net income Gini divided by the gross income Gini and multiplied by 100

The major findings of your paper are the threefold: Firstly, we can observe an increase in inequality of gross income for all countries included in this paper when facing expansionary monetary policy. Secondly, we find that the effect on net income inequality remains positive for countries with low redistribution. In contrast to this,

countries with high redistribution do not face the same positive reaction in their net income inequality. Thirdly, we show that monetary policy is transmitted via overall employment, labor income and capital income. We find that capital income increases disproportionately only in countries with a low redistribution while labor and capital related payments are impacted more equally in countries with high redistribution.

The remainder of the paper is organized as follows. First, we shed light on the data and the model incorporated in our analysis. Next, we show the overall effects of monetary policy shocks on gross as well as on net income inequality. We then focus on the two channels dealt in this paper: employment channel and income composition channel. We conclude after a short robustness section.

2 Data and Methodology

Before we proceed to our analysis of the nexus between monetary policy and its impact on the distribution of income as well as the underlying channels of transmission, we want to take a closer look at the data and methodology.

We want to compare the reaction of both, gross Gini and net Gini across selected countries which are distinguishable in regard to the level of inequality as well as the degree of governmental intervention and redistribution. We select representative countries by picking up the relative redistribution among OECD countries.⁷ Figure 11 in the Appendix shows the averages for all OECD countries within the SWIID dataset. The time period considered ranges from 1995 to the latest observation available for each country.

In order to analyze monetary policy shocks within a VAR framework we exclude all countries that are either part of a monetary policy union (i.e. the EMU) or directly peg their currency to the Dollar or the Euro for a substantial period. Thus, we include the three countries with the highest relative redistribution, which are

⁷The relative redistribution is defined as the difference between gross and net income Gini divided by the gross income Gini and multiplied by 100.

Sweden, Hungary and the Czech Republic. On the lower end, we incorporate South Korea, the U.S., and Canada. We exclude Mexico due to limited data availability when analyzing transmission channels.⁸

2.1 Data

In a first step we want to capture the reaction of Gini coefficients of gross incomes to monetary policy. We then evaluate in how far monetary policy shocks propagate to the dispersion of household's net incomes. For both estimations we use the corresponding mean estimators of the Standardized World Income Inequality Database (SWIID) of Solt (2016) for all countries included in this paper. Since we use a VAR model with quarterly data, we interpolate all Gini variables. Generally, measures of income inequality are considered a sticky variable so that interpolating them does not change their properties in a meaningful manner. Our sample starts in 1995 and ends with the last observation available in the SWIID 6.0 database. We pick 1995 as the starting point since all variables are available for each country here.⁹ Furthermore, by 1995 the Czech Republic and Hungary had already undertaken major transformation processes. Our sample ends in 2014 for Korea, Sweden, and the Czech Republic and in 2015 for the U.S., Canada, and Hungary.

We conduct baseline vectorautoregressions that include the gross Gini or net Gini coefficients for each of the six different countries, additional to the standard macroeconomic variables real GDP, consumer prices, a short-term interest rate, and the real exchange rate.¹⁰

Real GDP as well as CPI data are taken from Datastream. Real exchange rates are incorporated, because five of the six analyzed countries are small open economies

⁸In section 4.2 we compare the reaction of labor related income to the one of capital income after a monetary policy shock. We build our analysis on OECD data which are unfortunately not available for Mexico.

⁹This does not hold for the Czech Republic, where data availability forces us to start in Q1 1996.

¹⁰To account for non-stationarity we take the natural logarithm of real GDP and consumer prices. For sake of interpretation we also take the logarithm of the real exchange rate.

where the exchange rate channel appears to be the major monetary transmission mechanism. The corresponding trade-weighted real exchange rate stem from the Bank of International Settlements.¹¹

Our applied short term interest rates deserve some special attention. We generally prefer the use of money market rates. However, for Hungary and the Czech Republic money market data is not available for the entire time span analyzed here. We therefore have to draw on the key interest rate in those two countries. Furthermore, the zero lower bound becomes an issue in Canada, the Czech Republic, and the U.S.¹² For the U.S., the interest rate variable is the shadow rate by Wu & Xia (2016), available since 2003, and the effective Federal Funds Rate for previous periods. For Canada, we use a shadow interest rate estimated by MacDonald & Popiel (2016).¹³ Unfortunately, shadow interest rates are not available for the Czech Republic. For the Czech Republic we use the Eurozone shadow rate from Q4 2012. At this point in time the short term interest rate dropped to 0.05%. In 2013 the Koruna reached its upper limit set by the Czech National Bank. Eurozone shadow short term rates are therefore an eligible alternative. In order to overcome potential problems with a structural break, we also include an exogenous dummy variable that is one in Q4 2012 and zero otherwise.

¹¹Since the interpolated Gini coefficients do not show any seasonal patterns we also seasonally adjust real GDP and consumer prices. As short-term interest rates and exchange rates are free from seasonal patterns no adjustment is necessary. For the sake of comparability, we include the exchange rate in the U.S. model, although it is not a small open economy.

¹²In fact, in Hungary and South Korea the short term interest rate remains above 1% throughout the entire time considered. In Sweden, the short term interest rate is below 0.5 from Q3 2009 to Q2 2010 and from Q3 2014. However, due to the quick recovery in 2010 and the small number of periods where the ZLB might have been binding, we restrain from the incorporation of a shadow rate.

¹³We want to thank the authors for the provision of the data.

2.2 Methodology

With the described variables at hand, we estimate VAR-models with sign restrictions. In general, we use a reduced-form VAR model of the form

$$Y_t = A_p(L)Y_{t-p} + C + \varepsilon_t. \quad (1)$$

$A_p(L)$ is a lag-polynomial matrix of order p in lag-operator L , C captures deterministic components (here: an included constant) and ε_t is a column vector of reduced-form white noise error-terms and covariance matrix Σ_ε . The lag-length is determined by Akaike criterion, resulting in the following lag orders for the various countries:

Table 1: Country-specific lag order based on Akaike criterion.

	United States	Canada	South Korea	Sweden	Czech Republic	Hungary
Lags	1	2	2	1	1	1

Identification of our underlying, unknown structural model of the form

$$B_0 Y_t = B_p(L) Y_{t-p} + D + u_t, \quad (2)$$

and the respective shocks linked to it is conducted via sign restrictions. This requires a priori assumptions about the specific relations between the variables included in the VAR. These assumptions can root in theoretical considerations as well as in empirically robust common wisdom.¹⁴

As we are interested in interpreting the effects of monetary policy shocks in a sensible manner, we only focus on the identification of the monetary policy shock and ignore other structural innovations to the model. Table 2 shows the assumed restriction scheme.

¹⁴A detailed description of the idea and methodology can be found in Uhlig (2005).

Table 2: Sign restrictions for an expansionary monetary policy shock.

Variable	Gini	GDP	Prices	Interest Rate	REER
Imposed restriction	unrestricted	+	+	-	-

Notes: The imposed restrictions hold for four periods, but the results are not very sensitive to alternative durations.

We justify these assumptions as follows:

Expansionary monetary policy lowers overall market interest rates, either via policy rate cuts or monetary base expansion. This results in an stimulus of overall demand or at least does not cause demand to fall simultaneously. Overall prices should also adjust due to excess demand, or at least cannot be expected to decrease. The real exchange rate reaction is assumed to be negative because of capital outflows caused by overall lower yields in the economy. To capture the research question of this paper and to pick of the controversy outlined in the literature discussion we leave the variables related to income inequality unrestricted. All restrictions are theory-implied and also confirmed in many empirical applications. We think that identification via sign restrictions is superior to other approaches because we use interpolated (Gini) data and thus do not want to restrict contemporaneous relations between the variables via e.g. an assumed ordering.

3 Monetary Policy and Income Inequality

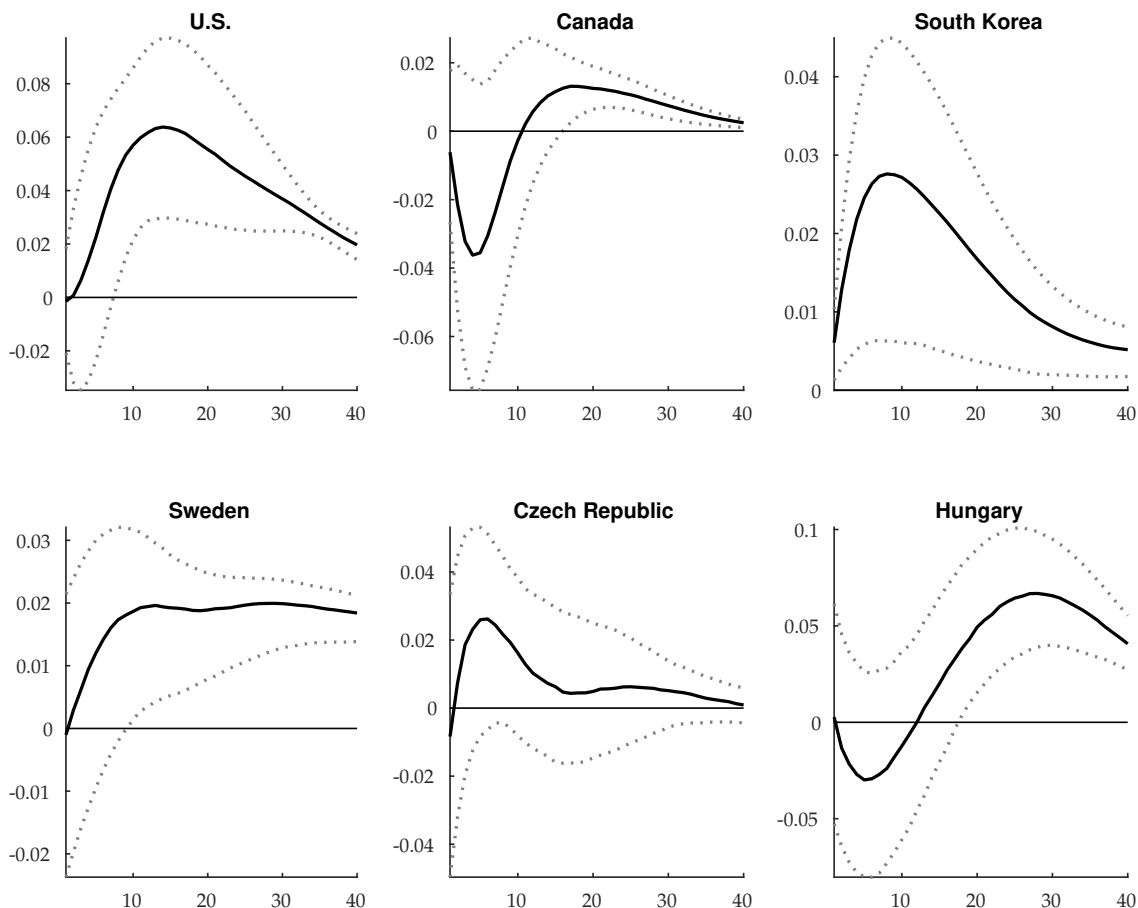
What is the nexus between monetary policy and inequality? Based on the aforementioned restrictions on GDP, prices, the policy rate, and the real exchange rate, we are able to pursue this question.¹⁵ In this respect, we distinguish between the Gini of gross income and net income. Since the discrepancy of gross and net incomes stems from (income-) taxes and transfers, we are thus able to tackle the question of their redistributive role.

¹⁵For the sake of greater clarity, we only depict the responses of the gini indexes. Since we use sign restrictions, the fundamentals react as intended. Nevertheless, the country specific estimates along with the fundamentals are available upon request.

3.1 Response of Market Income

We firstly evaluate the effect of expansionary monetary policy on the distribution of gross income. In Fig. 2 we plot the responses of Gini gross to the respective country specific monetary policy shock.

Figure 2: Response of Gini Gross



Notes: Impulse responses of Gini gross to an expansionary monetary shock. The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Two findings stand out. Firstly, in all countries but the Czech Republic, inequality increases. The effect is most pronounced for the U.S. given a peak median response of 0.06 after 15 quarters (solid line), followed by Hungary. For the other countries, the Gini index increases by 0.01 and 0.03.

Secondly, the effect comes with some delay. It takes between 8 and 18 quarters until the probability bands surpass the zero line. This finding comes at no surprise

since the Gini index itself is rather sticky. Accordingly, the effect seems to be persistent since it seldom dies out after 40 quarters. Only in South Korea the Gini reacts contemporaneously indicating a faster transmission of monetary policy shocks towards more inequality in the dispersion of gross income.

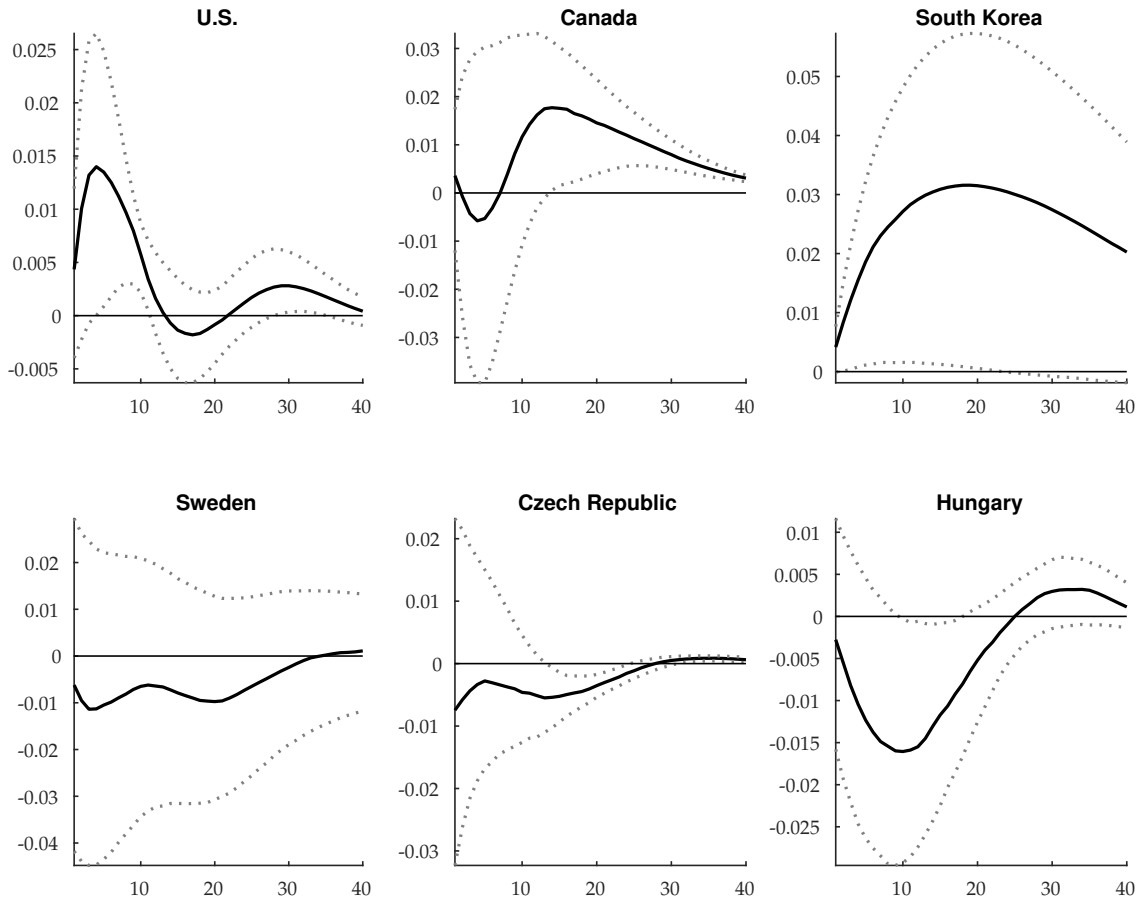
3.2 Response of Net Income

Focusing on net income Gini coefficients brings several advantages. First, the general debate about equitable income distribution is predominantly based on net values, so that potential mitigating effects through governmental redistribution are incorporated. Furthermore, wealth is largely accumulated by savings that stem from net income. Thus, analyzing net income inequality also sheds light on changes in the wealth distribution. Finally, we can show in how far taxes and transfers impact the observed distributional effects of monetary policy.

Figure 3 outlines the results of the baseline model including the Gini of net income as our measure of inequality. It stands out that the effect of an expansionary shock is mostly tempered as against the response of Gini gross in Fig. 2. For the U.S., we find a positive reaction in the short-term that is notably smaller, namely 0.015 at its peak, than the rigid increase in Gini gross with its maximum at 0.06. The mitigating effect is most pronounced in Sweden, the Czech Republic, and Hungary - the countries with the highest relative redistribution in our sample. Here, the tendency for an increase in inequality is either leveled out (Sweden) or even reversed (Czech Republic and Hungary). The latter finding indicates that the stimulating effect of loose monetary policy in these countries benefits low- and middle-income households disproportionately.

The effect in South Korea, the country with the lowest level of inequality in our sample, while unchanged in the magnitude, is now not contemporaneous and dies out faster. Finally, we find no notable difference in the response of the Gini net in Canada as against the response of Gini gross. Inequality in Canada increases in the

Figure 3: Response of Gini Net



Notes: Impulse responses of Gini net to an expansionary monetary shock. The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

aftermath of an expansionary monetary policy shock.

In summary, we find that governmental distribution seems to dampens the negative effect of monetary policy on income inequality. Furthermore, it seems the extend of redistribution matters more than does the initial level of inequality. Sweden, the Czech Republic, as well as Hungary - countries with the highest relative redistribution in our sample - experience the the strongest dampening effect. In contrast, the country with the lowest level of inequality, South Korea, undergo an increase in both, gross Gini and net Gini.

4 Transmission of Monetary Policy on Inequality

In this section we want to elaborate what channel-related variables are involved in the transmission of monetary impulses to overall income dispersion. As outlined above, we focus on the employment channel and the income composition channel. We pick up the ideas of Bernanke & Gertler (1995) who disentangle overall transmission of monetary policy shocks to real economy by taking a closer look at variables assumed to be involved in the transmission. With this approach they shed light on major driving forces and related channels of monetary transmission linked to them. Similarly, we use variables related to the channels outlined previously to account for the variety of possible mechanisms that drive the movement observed in the overall Gini coefficients presented in chapter 3. These variables replace our Gini coefficient in the baseline VAR-model while identification assumptions remain the same. We proceed as follow: First, we check in how far the employment channel is involved in the transmission of monetary policy. Second, we separately include both components of the income composition channel in our VAR-model. Third, we relate them to each other to figure out in how far their ratio is affected by monetary policy, or, in other words: Does the reaction of one income component dominate the reaction of the other. Thus, we need variables that can be assigned to the channels to assess the importance and overall role each channel plays in the six countries. We describe them in the following in more detail. These variables are then incorporated in our VAR framework to clarify their behavior in the presence of monetary policy shocks.

4.1 Employment Channel

Data

To investigate the employment channel we check in how far employment reacts to monetary policy shocks. In contrast to most literature, we do not use unemployment rates, but overall employment instead because the officially reported rates are

often biased due to the fact that not every unemployed person registers. Additionally, we use long-run data so that changes in the labor force participation might distort unemployment rates although overall employment remains less affected or even unchanged. Thus, our measure captures more precisely the real utilization of the factor labor in our sample. In order to have a common data source we rely on total employment provided by the OECD.

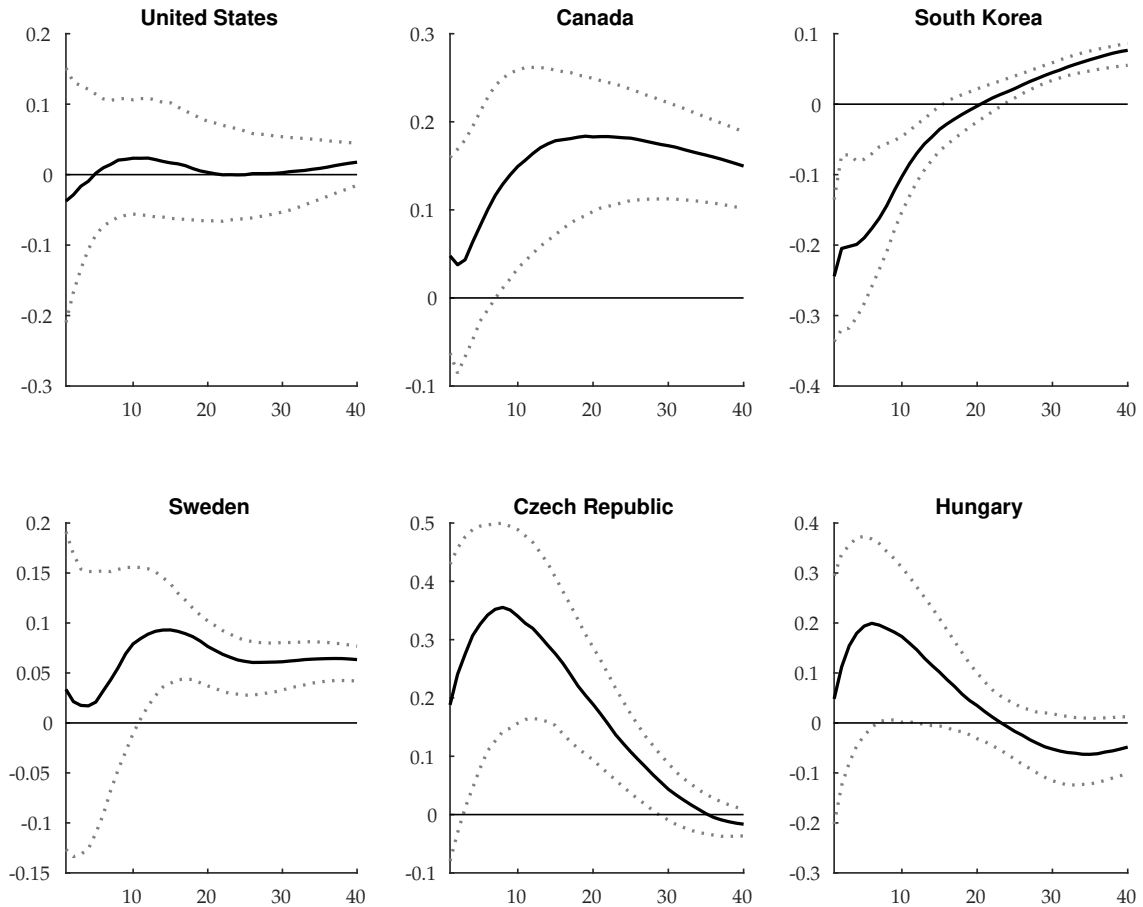
Results

According to the employment channel, an expansionary monetary policy shock lowers income inequality through its stimulating effect on the labor market and thus gains in income, especially for the low-skilled low-income households. To evaluate the relevance of the channel, we replace the Gini variable by the ln of total employment in the respective country.¹⁶

Figure 4 shows the impulse responses of employment to an expansionary policy shock. Such shocks have a notable stimulating effect in Canada, Sweden, the Czech Republic, and Hungary. It are the three last mentioned countries, whose net Gini decreases after such shock. That is, the stimulating effect benefits the low-income households disproportionately such that overall inequality concerning disposable income decreases.

¹⁶Due to data issues in the U.S. we proxy the total number of employed persons by the employed workers according to the non-farm payroll.

Figure 4: Monetary Policy Shocks and Employment



Notes: IRFs of employment to an expansionary monetary policy shock. The solid line reflects the median response, the dotted lines show the 16th and 84th percentiles.

For Canada, despite the stimulating effect on the labor market, the previous increase in net Gini indicates that other channels dominate.

To our surprise, we find no notable effect of an expansionary policy shock on employment for the U.S. Furthermore, the response of employment in South Korea is puzzling, too. After a notable decrease in employment it increase after roughly 20 quarters.

Altogether, while we find some indication for the employment channel (Sweden, Czech Republic, Hungary), we find no clear evidence given the diverging responses across countries and no clear patterns.

4.2 Income Composition Channel

Data

As already mentioned, the income composition channel distinguishes between major sources of households' overall earnings: labor related income and capital pay-offs. Thus, we include these different sources in a more specific way into our analysis. As we are primarily interested in net-effects, we focus on disposable income. National accounts and (personal) income statistics provide detailed data to construct different variables based on the subcomponents related to the production factors capital and labor. More precisely, in our analysis capital income consists of net interest income, dividends after taxes and net rental income. It is computed as the sum of net-operating surplus and net mixed income (NOS+MI).¹⁷ Labor income incorporates solely (net) compensation of employees, i.e. wages, salaries and employers' social contributions.¹⁸ Again, we rely on data from the OECD in order to overcome possible problems of inter-country comparability.¹⁹

For Korea, all income data are only available on a yearly frequency. We therefore have to interpolate capital and labor related income. For the Czech Republic, net operating surplus and mixed income is only available from 1999. Since gross operating surplus and mixed income (GOS+MI) is accessible from 1996, we construct NOS+MI from 1996 to 1998 by assuming the share of NOS+MI in GOS+MI in this time is identical to the share in 1999.²⁰ For Hungary, the OECD provides quarterly data for labor related income and GOS+MI, but only yearly data for NOS+MI. This time we first construct each quarters share in the yearly values of GOS+MI. We then assume that the share for NOS+MI is identical.

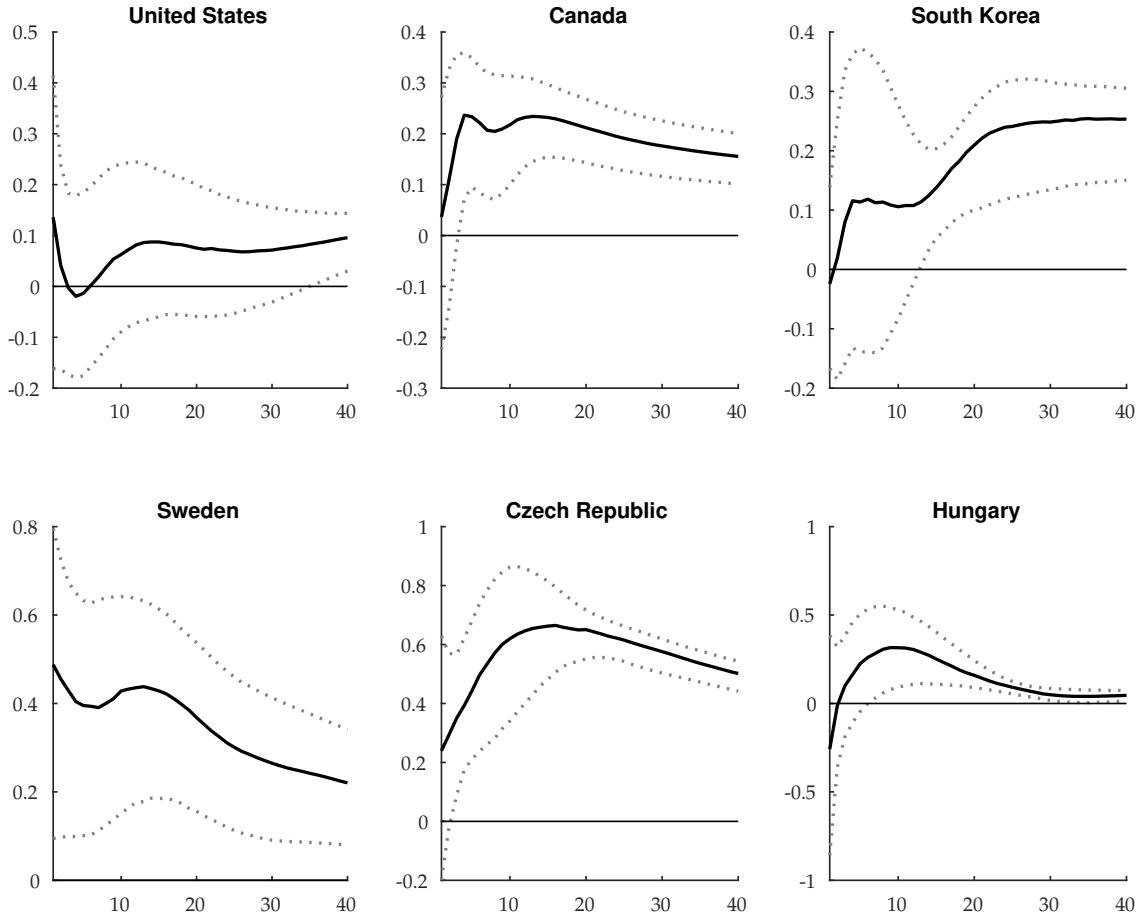
¹⁷That is, gross operating surplus less consumption of fixed capital for the corporate sector.

¹⁸Including transfers, for some households the major income source, would have been an option if all countries collect and process data on a similar approach and provide them for sufficient long periods. Unfortunately, for the sake of inter-country-comparability, we can not include them here in a meaningful manner.

¹⁹All data are seasonally adjusted and denoted in constant prices.

²⁰In fact the share NOS+MI in GOS+MI varies between 55% and 62% from 199 to 2014. So that the variation is fairly small.

Figure 5: Monetary Policy and Labor Income



Notes: IRFs of labor related income to an expansionary monetary policy shock. The solid line reflects the median response, the dotted lines show the 16th and 84th percentiles.

Response of Labor Related Income

We replace the Gini variable in the baseline model by the ln of labor related income. Since labor income and employment are highly correlated, their outcomes are expected to be similar, too.

The results are represented in Fig. 5. In all countries, labor related income increases after an expansionary shock. The median responses vary between 0.1 and 0.6 percentage points.

We can not draw conclusions about the distribution of labor itself. Nevertheless, labor income is the main source for the vast majority of households. In combination with the findings we draw from the employment channel, the results on labor related

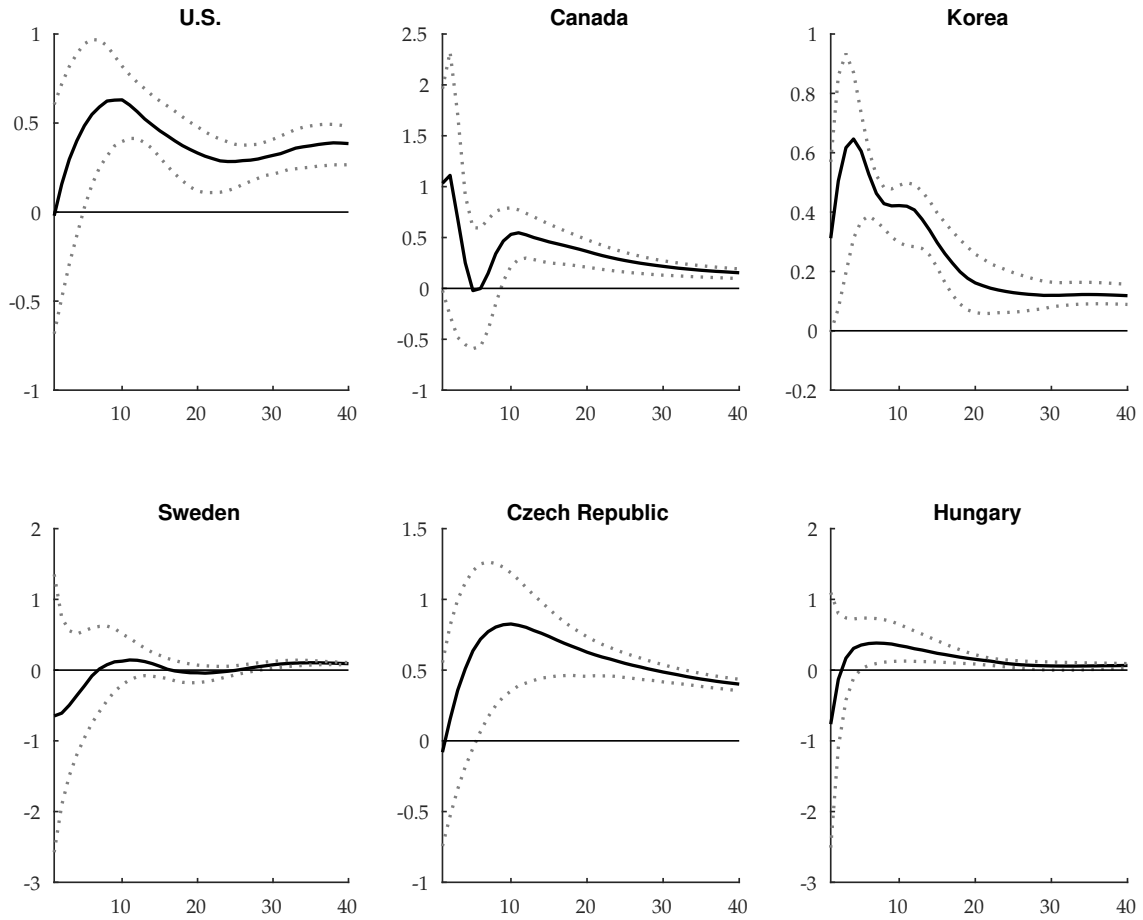
income indicate that employees profit from an expansionary monetary policy shock. Thus, mitigate tendencies of the unequal distribution of income.

Response of Capital Income

To receive aggregate net capital income, we sum up net operating surplus and net mixed income. High-income households are supposed to be the main receiver of capital income. Thus, an increase in capital income indicates that this households benefit disproportionately as opposed to low- and middle-income households.

Figure 6 indicates a similar reaction of capital related income after taxes and transfers as labor income. The predominantly response is an increase in capital income. This comes at no surprise since loose monetary policy boosts asset prices. Furthermore, the stimulus for the real economy leads to increasing corporate profits and thus higher capital earnings for stake holders.

Figure 6: Monetary Policy and Capital Income



Notes: IRFs of capital related income to an expansionary monetary policy shock. The solid line reflects the median response, the dotted lines show the 16th and 84th percentiles.

We find the most pronounced response for Canada and the Czech Republic, followed by the U.S. and South Korea. Only capital income in Sweden and Hungary does not react notably.

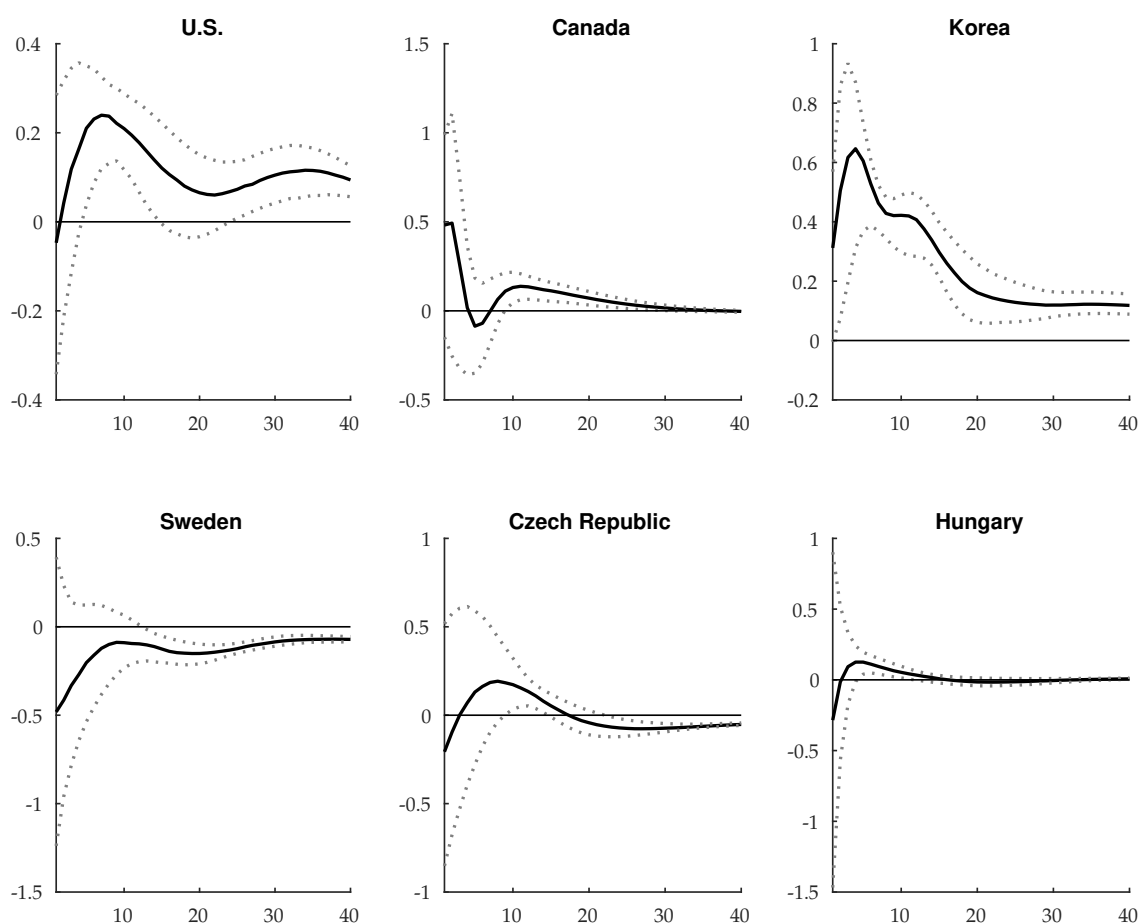
Response of the Capital-Wage-Ratio

As has been shown above, an expansionary monetary policy shock can lead to an increase in both, capital income and labor related income. Depending on the composition of income among households, this leads to either a rise or fall in inequality. The income composition channel states that income inequality hikes if capital income increases disproportionately, and vice versa. Hence, we finally evaluate its existence

by the behavior of the capital-wage ratio after such monetary policy shock. Since labor related income also represents changes in employment, the capital-wage ratio is not only suited for the evaluation of the income composition channel. It also indicates whether the income composition channel is dominating the employment channel.

The respective impulse responses are presented in Fig. 7. Our findings are mixed. For the U.S. and South Korea, we find a notable increase in the capital-wage-ratio in the aftermath of a monetary policy shock.

Figure 7: Monetary Policy and the Capital-Wage-Ratio



Notes: IRFs of the capital-wage-ratio to an one standard deviation expansionary monetary policy shock. The solid line reflects the median model reaction, the dotted lines show the 16th and 84th percentiles.

In the case of South Korea, the highly persistent effect peaks at approximately 0.6 after 3 quarters and eventually decreases. That is, in the short-term, capital gainers

benefit even more. In the mid- and long-term, labor income surges while capital income increases relatively slow. The fast increase of the capital-wage-ratio in the short-run is because asset prices can adjust more quickly than do wages. The same is true for the U.S., Canada, and Hungary. Yet, the adjustment of labor income happens faster in Canada and Hungary, as indicated by the probability band, which encompass the zero-line durably after 25 and 13 quarters, respectively.

While capital owners benefit disproportionately in the short-term in the Czech Republic, this effect is reversed after roughly 20 quarters. In Sweden, net labor related income benefits consequently given the decrease in the capital-wage-ratio in the aftermath of an expansionary monetary policy shock.

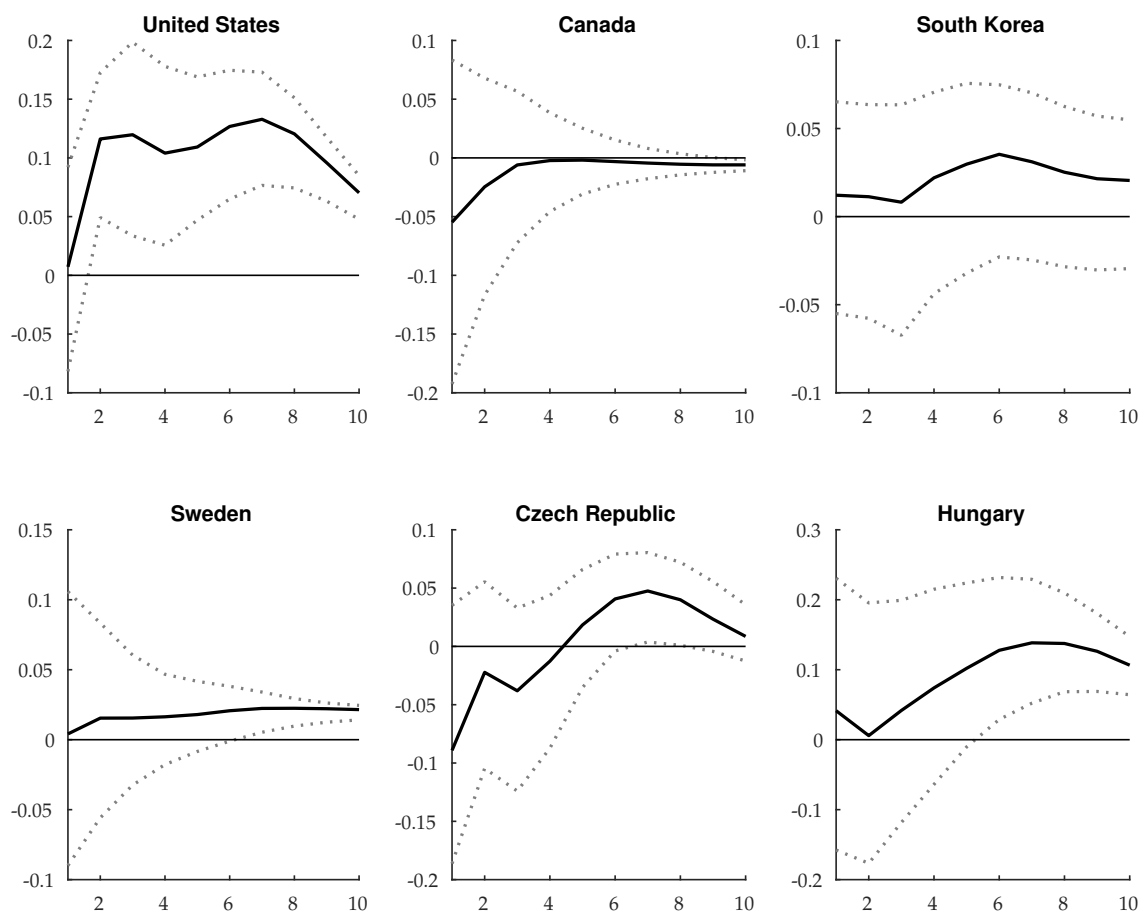
5 Robustness

We check the accuracy of our interpolated data by estimating VAR models with the originally series based on yearly frequency. With the shorter sample size we now incorporate one lag only and reduce our restriction duration to one period as well. Nevertheless the short sample boosts uncertainty in the estimation and thus the resulting percentiles of the presented model should be treated with caution. Despite that the major outcomes remain unchanged.

Response of Gini Market

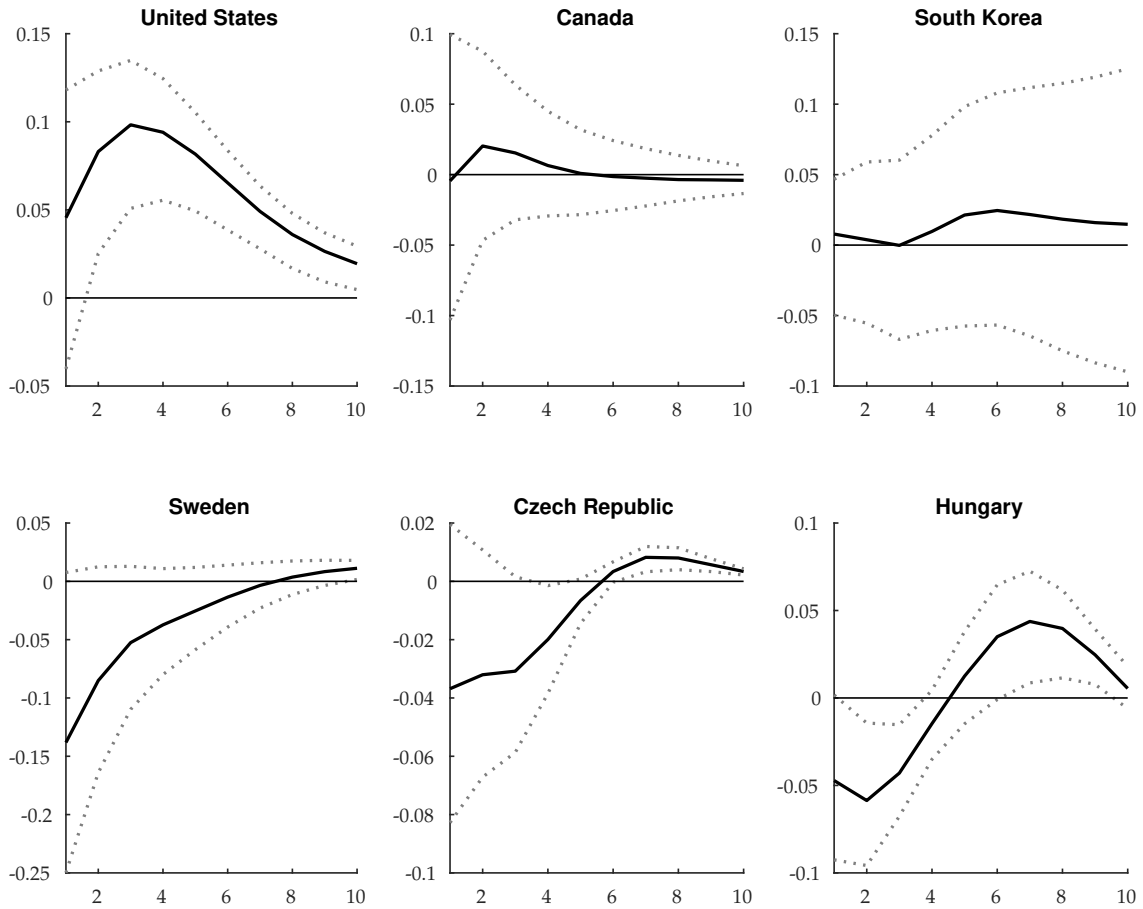
We again start by showing impulse-responses of Gini net reactions (see Fig. 8). In line with the findings from 3.1 there is a tendency of an increase in inequality after an expansionary monetary policy shock. In fact, five of the six countries increase. Only Canada shows no clear reaction pattern. We therefore confirm that the increase in the Gini gross is independent from the degree of redistribution.

Figure 8: Monetary Policy and Gross Gini



Notes: IRFs of gross Gini to an expansionary monetary policy shock. Estimates with yearly data. The solid lines reflect the median responses, the dotted lines are the 16th and 84th percentiles.

Figure 9: Monetary Policy and Net Gini

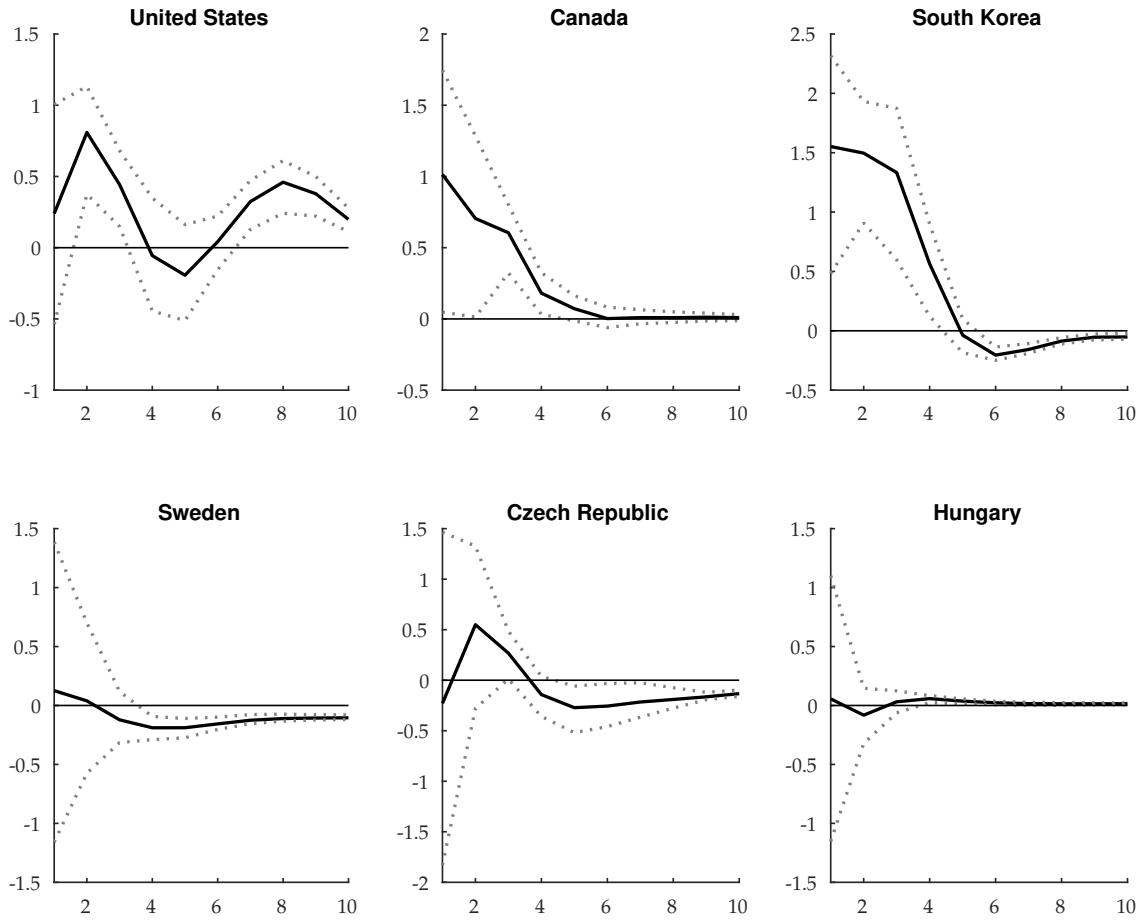


Notes: IRFs of net Gini to an expansionary monetary policy shock. Estimates with yearly data. The solid lines reflect the median responses, the dotted lines are the 16th and 84th percentiles.

Response of Gini Net

The impact of expansionary monetary policy shocks on the Gini coefficient of net incomes, Fig. 9, is again quite heterogeneous across countries. In those economies characterized by a high degree of redistribution a tendency of less inequality can be observed. In contrast, countries with little governmental interaction show no or, for the U.S., a positive reaction. The mitigating effects of governmental interventions can hence be supported by these outcomes.

Figure 10: Monetary Policy and the Capital-Wage-Ratio



Notes: IRFs of the capital-wage-ratio to an expansionary monetary policy shock. Estimates with yearly data. The solid lines reflect the median responses, the dotted lines are the 16th and 84th percentiles.

Response of Capital-Wage-Ratio

Our main income composition channel variable, the capital-wage-ratio, also indicates that the two major income components, capital earnings and wages, are affected differently, depending on the country (see Fig. 10). For the U.S, Canada and South Korea a rise in this ratio can be testified, indicating a disproportionality in favor of capital earnings. In contrast, in Sweden as well as the Czech Republic this ratio shows negative reaction patterns which have to be linked to a more intense surge in the denominator of the ratio. For Hungary we see a slightly positive reaction, similar to the results of the previous section.

6 Conclusion

In the recent decade, the problematic issue of rising income inequality gained more and more attention in the public perception as well as in the political debate. The today observable historically high levels of income dispersion are accompanied by an environment of very expansionary monetary policy. In this respect, we add new empirical evidence to the current controversy.

To assess the effects of monetary policy shocks, we incorporate Gini coefficients in a standard macroeconomic VAR-model consisting of GDP, consumer prices, a monetary policy variable and the corresponding trade-weighted real exchange rate. Identification is conducted via sign restrictions. Gini coefficients of gross incomes increase in all six countries when facing an expansionary monetary policy shock. In contrast, the reaction of the net income dispersion varies between the countries: The countries with a relatively low degree of redistribution, namely the U.S., Canada, and South Korea, also show a notable positive reaction in Gini net in the presence of expansionary monetary policy shocks. On the contrary, this measure does not increase in countries with a high degree of redistribution after an expansionary monetary policy shock.

Furthermore, we take a more detailed look on the importance of two major transmission channels, the employment channel and the income composition channel. The reaction of employment, captured by the total number of employed people, shows the expected positive sign in four of the six countries. Again the reaction is stronger and more likely in the countries with a high degree of distribution indicating that the employment channel is at work here. By splitting the composition of net national income in its major parts, labor related income and capital related income, we can evaluate which of these income categories profits disproportionately. While both components are generally affected positively throughout the six considered countries, their ratio indicates that in the U.S. and South Korea capital owners benefit disproportionately. As an increase in labor related income also goes

in hand with an increase in employment, we conclude that the income composition channel is the major transmission channel of monetary policy to income inequality. In contrast, in Canada, the Czech Republic and Hungary no clear reaction patterns to monetary policy shocks can be found. Sweden's capital-wage-ratio even reacts notably negative after an expansionary monetary policy shock. Thus, in states with a high degree of redistribution both income sources seem to profit in a similar manner. This conclusion is in line with the insignificant reaction of Gini net that is solely observed in these countries. We thus conclude that distributional effects of monetary policy can be mitigated or even offset by the government via welfare state, fiscal and tax policy.

The resulting implications of this paper are the following. Firstly, monetary policy affects (gross) income inequality. In this respect the income composition channel dominates the employment channel meaning that capital owners benefit disproportionately. Yet, the paper shows that fiscal policy makers can effectively dampen side effects of monetary policy on income inequality. As a result, there is no need to amend the Central Banks' objective function towards an inequality related criterion. Secondly, as capital income recipients seem to profit disproportionately from an ease in monetary policy, adjustments in taxation might be one solution to thwart increasing income inequality.

Further on, wealth inequality was not addressable in this paper due to the lack of comparable and sufficiently processed data. We think that especially this type of inequality is an even bigger issue for the ongoing socio-economic debate and future policy makers.

Additionally, the relevance of the distinct channels is probably changing over time as well as state-dependent, i.e. if we face an expansionary monetary policy environment during conventional or unconventional times. We leave this for future research.

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