

How unconventional is green monetary policy?

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EEA Lecture January 2021

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Unconventional monetary policy

- Low interest rate environment
 - ▶ main tool for (unconventional) monetary policy: asset purchases
 - ▶ government bonds, MBS, most recently **corporate bonds**
 - What bonds to buy? How about "green bonds"?
- Conventional view
 - ▶ monetary policy should aim for "**market neutrality**"
 - ▶ bond purchases proportional to bonds outstanding
e.g. government bonds by maturity & country
 - ▶ idea: minimize relative price distortions from asset purchases
- This paper: **What is "market neutrality" for corporate bonds?**

Green monetary policy?

Recent debate on ECB bond portfolio

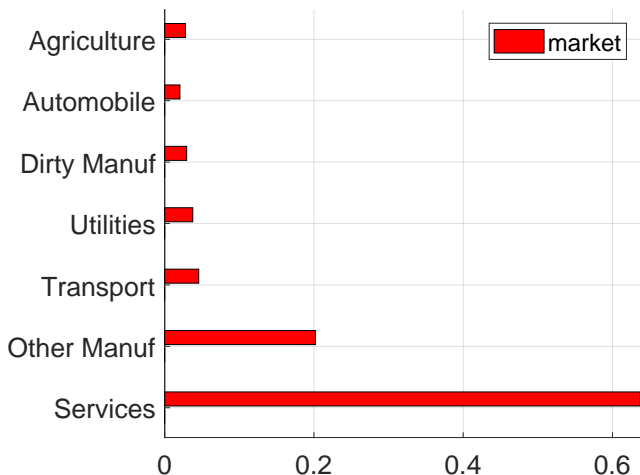
- ▶ Bundesbank President Jens Weidmann in Oct 2019:
"Our mandate is to preserve price stability, and policy implementation needs to be in line with principle of **market neutrality**. Skewing asset purchases to green bonds, say, would run counter to this principle, which is anchored in Article 127 of the EU Treaty."
- ▶ ECB Exec Board Member Isabel Schnabel in Sept 2020:
"We could also consider reassessing the benchmark allocation of our private asset purchase programmes. In the presence of market failures, **market neutrality** may not be the appropriate benchmark for a central bank when the market by itself is not achieving efficient outcomes."

This paper

- Simple theoretical framework
 - ▶ multisector growth model with climate externalities
 - ▶ central bank purchases (may) increase convenience yield on assets
 - ▶ **market neutrality** = rel. returns on *capital* across sectors unchanged
 - ▶ assessing neutrality of central bank purchases depends on
 1. relative importance of bond finance across sectors
 2. firms' marginal cost of raising funds outside bond market
 3. structure of bond market (e.g., its segmentation)
 - Empirical exercise focuses on relative importance of bond finance
 - ▶ construct measures of **market portfolio** = sectoral capital stocks
 - ▶ compare sector shares: capital, bonds outstanding, ECB holdings
- Differences in bond finance a key source of non-neutrality
- ▶ ECB portfolio \approx bonds outstanding \neq **market portfolio**
 - ▶ ECB portfolio looks like **sector shares of emissions**;
large firms in dirty industries: more bonds & more emissions

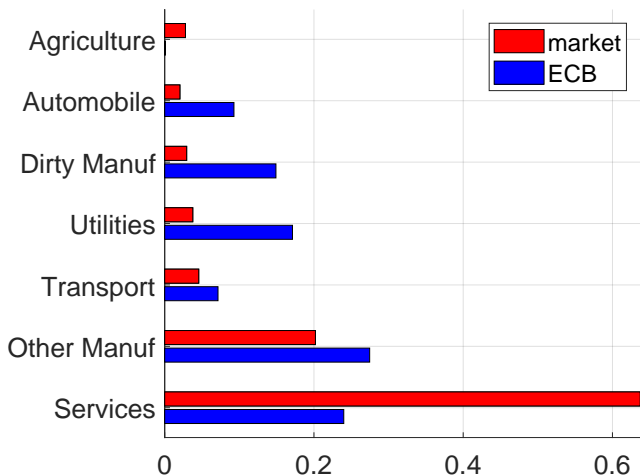
Market portfolio vs ECB portfolio

Dirty Manuf = oil & coke, chemicals, basic metals, nonmetallic minerals



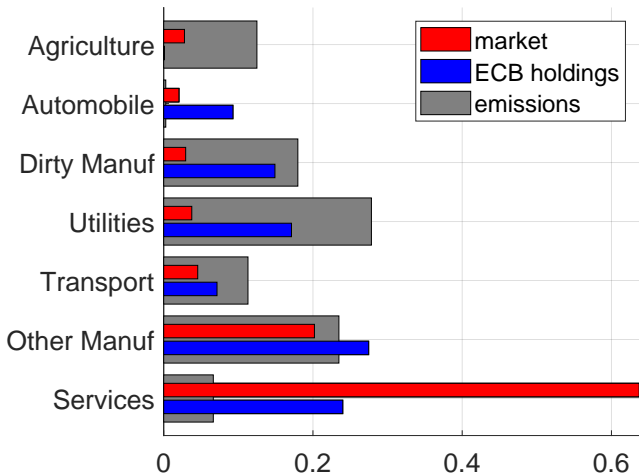
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ECB portfolio looks more like emission shares

Dirty Manuf = oil & coke, chemicals, basic metals, nonmetallic minerals



Literature

- **Unconventional monetary policy**
 - ▶ **price impact**: Krishnamurthy-VissingJorgensen 2011, Williams 2014, Krishnamurthy-Nagel-VissingJorgensen 2018, Hamilton 2020, Mota-Papoutsis 2020
 - ▶ **economic mechanisms**: Gertler-Karadi 2011, Curdia-Woodford 2011, Piazzesi-Schneider 2018, Piazzesi-Rogers-Schneider 2020
- **Green investing**
 - ▶ **price impact**: Baker-Bergstresser-Serafeim-Wurgler 2018, Zerbib 2019, Jagannathan-Ravikumar-Sammon 2019, Barber-Morese-Yasuda 2020, Pedersen-Fitzgibbons-Pomorski 2020, Pastor-Stambaugh-Taylor 2020, Bolton-Kacperczyk 2020
 - ▶ **role of institutional investors**: Ilhan-Krueger-Sautner-Starks 2019
- **Climate change & financial markets**: Barro 2013, Bansal-Kiku-Ochoa 2017, Daniel-Litterman-Wagner 2019, Hsu-Li-Tsou 2019, Hong-Li-Xu 2019, Engle-Giglio-Kelly-Lee-Stroebel 2020, Giglio-Maggiore-Stroebel 2020, Giglio-Kelly-Stroebel 2020, Baldauf-Garlappi-Yannelis 2020, Choi-Gao-Jiang 2020

Organizing framework

- Rep agent with preferences over consumption & temperature

$$\sum_{t=0}^{\infty} \beta^t (u(C_t) - v(\tau_t)); \quad C_t = g(c_t^1, \dots, c_t^N) \quad \text{aggregates bundle}$$

- N sectors produce goods & emissions that drive up temperature

$$y_t^n = f^n(k_t^n, l_t^n); \quad \tau_t = h\left(\tau_{t-1}, \sum_{n=1}^N \kappa_t^n y_t^n\right)$$

- Resource constraint

$$C_t + \sum_{n=1}^N k_{t+1}^n = Y_t = g(y_t^1, \dots, y_t^N)$$

- Simplifying but not essential
 - ▶ separable utility, full depreciation, special IO structure
 - ▶ no explicit energy good; emissions by-product of production

Asset pricing & allocations

- Rep agent with preferences over consumption & temperature

$$\sum_{t=0}^{\infty} \beta^t (u(C_t) - v(\tau_t)); \quad C_t = g(c_t^1, \dots, c_t^N)$$

- Asset prices & investment in (inefficient) competitive equilibrium

$$p_{t+1}^n f_1^n(k_{t+1}^n, l_{t+1}^n) = R_t = \frac{u'(C_t)}{\beta u'(C_{t+1})}$$

- ▶ firms equate marginal product of capital to rate of return
- ▶ investors equate MRS to rate of return
- Why might central bank asset purchases matter?
 - ▶ firms fund capital with equity & debt = loans + bonds
 - ▶ central bank buys bonds, issues reserves held by banks
 - ▶ banks issue inside money backed by reserves (+ loans + securities)
- repackaging of capital: hh sector holds some capital in form of money
 - ▶ what is the deviation from Modigliani-Miller?

Real effects of unconventional monetary policy

- Capital provides nonpecuniary benefit $b^n(x_t^n, k_t^n)$
 - ▶ central bank purchases $x_t^n \leq k_t^n$ affect benefit
 - ▶ homothetic: higher share x/k increases benefit per unit of capital
 - ▶ reduced form captures various mechanisms in the literature:
convenience yield of inside money backed by bonds,
better risk allocation in constrained intermediary sector,
better monitoring/enforcement

- Preferences over consumption, temperature & assets

$$\sum_{t=0}^{\infty} \beta^t \left(u(C_t) - v(\tau_t) + \sum_{n=1}^N b^n(x_{t+1}^n, k_{t+1}^n) \right)$$

- Asset prices & investment

$$p_{t+1}^n f_1^n(k_{t+1}^n, l_{t+1}^n) = R_t^n = \frac{u'(C_t) - b_2^n(x_{t+1}^n/k_{t+1}^n, 1)}{\beta u'(C_{t+1})}$$

- ▶ investors require lower return R^n if $b_2^n > 0$, investment cheaper
- ▶ targeted purchases change capital allocation & emissions

Market neutrality

- **Market neutrality:**
 - ▶ asset purchases do not change relative allocation of capital
 - ▶ relative returns across sectors stay unchanged

$$p_{t+1}^n f_1^n(k_{t+1}^n, l_{t+1}^n) = R_t^n = \frac{u'(C_t) - b_2^n (x_{t+1}^n / k_{t+1}^n, 1)}{\beta u'(C_{t+1})}$$

- ▶ policy is not optimal, room for policy to reduce emissions
- What determines shape of b^n , size of real effects in sector n ?
 1. relative importance of bond finance: $x^n = 0$ if no bonds
 2. whether central bank can affect *marginal* funding cost from all sources (otherwise sector may adjust leverage but not capital)
 3. structure of bond market determines the size of price impact
- Empirical exercise in this paper: relative importance of bond finance
 - ▶ benchmark $b^n = b$, **market neutrality** means equal x^n/k^n
 - ▶ $k^n = \text{equity}(n) + \text{loans}(n) + \text{bonds}(n)$ and $x^n \leq \text{bonds}(n)$
 - ▶ measure x^n/k^n : dirtier firms issue more bonds, held more by ECB

Data

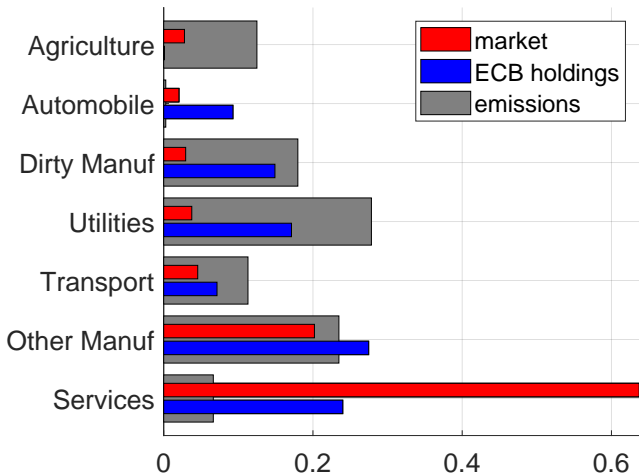
- At individual firm level, we merge
 - ▶ ECB purchases & holdings of individual corporate bonds
 - ▶ Bonds outstanding of individual firms
 - ▶ Scope 1, 2 and 3 emissions (by subcategory) from Urgentem
- Sector level
 - ▶ Scope 1 emissions by Nace 2 from air emissions accounts in Eurostat
 - ▶ Value added, wages & output by Nace 2 from Eurostat
 - ▶ Output & total book assets by Nace 2 from Orbis
- Important: special purpose entities
 - ▶ example: ECB buys bonds from Royal Dutch Shell (oil manufac), bonds are issued by Shell International Finance BV (finance sector)
 - ▶ we research these entities and attribute bonds to right sector
reduces ECB holdings of finance sector from 56% to 11%
- From now on, only consider nonfinancial firms

Market shares by sector

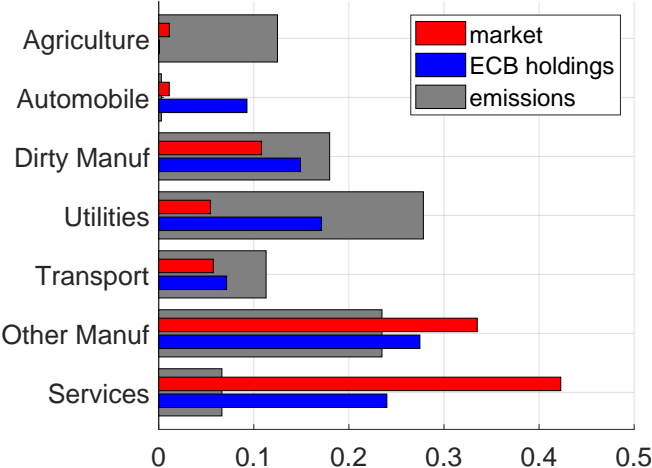
- Share of sector capital k_{t+1}^n in total capital $\sum_{n=1}^N k_{t+1}^n$
 - Ideal measure: market value of equity + debt
 - Two simple measures of sector capital k_{t+1}^n
 1. benchmark: $p_{t+1}^n f_1^n (k_{t+1}^n, l_{t+1}^n) = R_t$
with identical rates of return and depreciation rates across sectors,
capital income $R_t k_{t+1}^n$ implies capital k_{t+1}^n ,
measure capital income = value added – wages in Eurostat
 2. output from Eurostat \times book assets to revenues from Orbis
- Same result with both measures:
ECB portfolio looks like emission shares, not market shares

Market shares measured from capital income by sector

Dirty Manuf = oil & coke, chemicals, basic metals, nonmetallic minerals



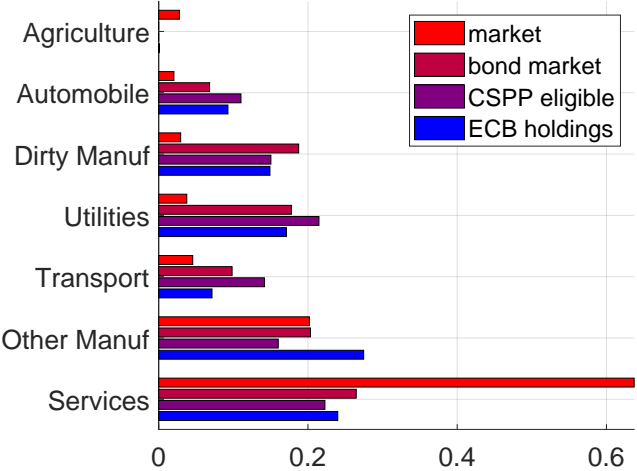
Robustness with total assets from Orbis



Explanation

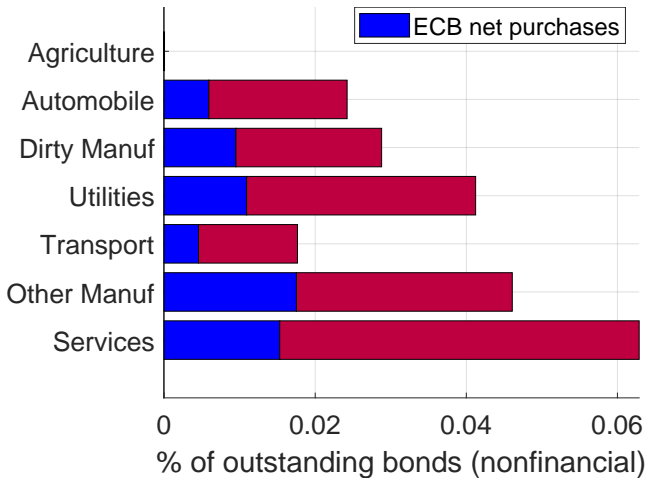
- Compare market shares by sector to
 - ▶ bonds outstanding by sector
 - ▶ CSPP eligible bonds by sector (investment grade, maturity, etc)
 - ▶ ECB holdings
- Basic finding
 - ▶ sectors with high emission shares issue many bonds
these are sectors with large fixed assets that serve as collateral
 - ▶ CSPP eligibility criteria do not change basic finding

Comparison with bonds outstanding & CSPP eligible bonds



ECB is a large investor in corporate bonds

New bond issuance by sector as fraction of outstanding bonds

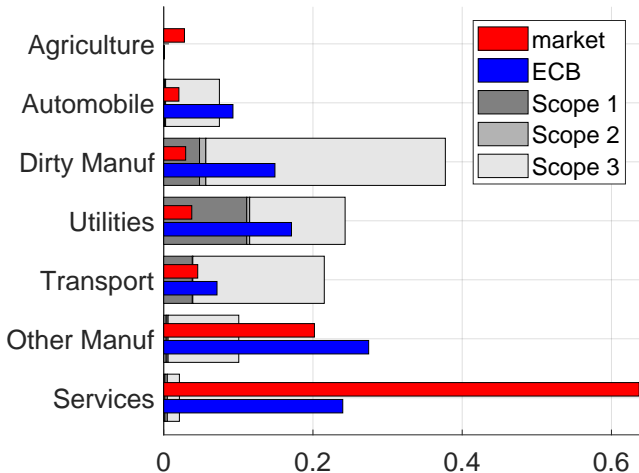


Broader measures of carbon footprint

- All results so far:
 - ▶ direct emissions from Eurostat
 - Firm-level data on emission intensities
 - ▶ emission intensity = emissions per revenue
 - ▶ direct emissions (scope 1), indirect through electricity use (scope 2), indirect emissions through product use (part of scope 3)
 - ▶ scope 1 numbers aggregated from Urgentem firm survey close to sectoral Eurostat data
 - Accounting for indirect emissions
 - ▶ average scope 2 intensity by sector similar to scope 1
 - ▶ scope 3 intensity higher for automobiles, utilities & transport only
small increase for services
- ECB portfolio appears dirtier

Portfolios & Scope 1, 2 and 3 emission intensities

Emission intensities shown as tons CO₂-equivalent / 10bn Euro revenue



Summary

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