



Do monetary policy shocks and economic conditions impact innovation? Evidence from Australian administrative data

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Views are that of the authors and not the Bank

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Motivation

- We tend to assume that economic conditions and monetary policy cannot affect productivity.
- Growing literature arguing that economic conditions can influence the amount of innovative activity in the economy, and therefore have medium-run effects on productivity and output – hysteresis
 - Particular focus on recessions (Comin and Gertler 2006; Anzoátegui et al 219; Bianchi, et al 2019)
 - R&D literature has also alluded to macroeconomic shocks having long run effects (Barlev 2007) and the innovation activity can be counter cyclical.

Motivation

- Some recent papers have argued that monetary policy can have medium-run effects be influencing innovation and productivity:
 - Moran and Queralto (2018):
 - Contractionary MP can lessen R&D spending and therefore productivity in US, driven be weaker demand
 - Sizable impact:
 - » If US MP not constrained post-GFC, productivity and output would be 2 per cent higher
 - » Slower tightening from 2016, productivity and output 1 per cent higher
 - Ma (2022):
 - Similar results, but focusing on patenting
 - Key role for credit constraints
- These papers often highlight importance of **stabilising economic activity**

Motivation

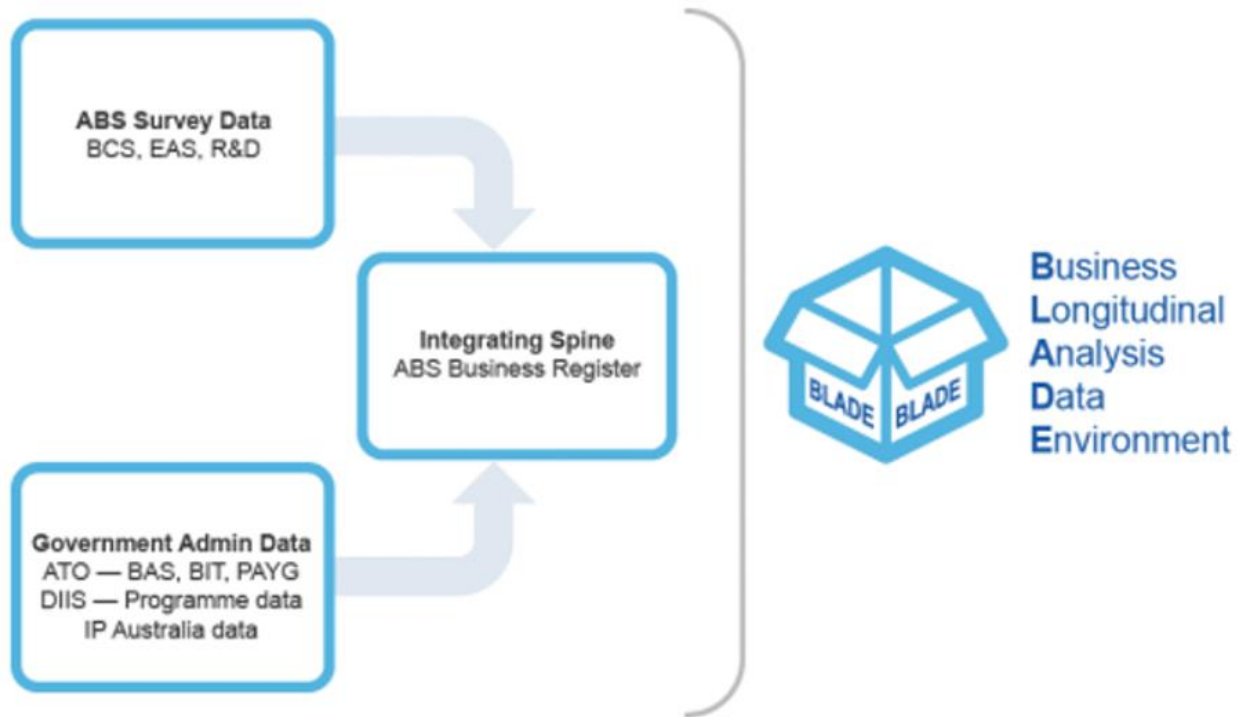
- Our contribution:
 - Examine in the context of SOE that imports technology (rather than invents)
 - Explore a broader set of innovation metrics, including adoption
 - Key mechanism in MQ model, but not explored empirically
 - Look at heterogeneity, study if the impact is different by firm size
 - Examine the mechanisms in more comprehensive manner, using detailed firm-level data
 - Demand channel, credit constraints, and lower input costs.
 - ...I won't go into too much detail on the channels...

Measuring innovation

- There is no perfect way of measuring innovation. Several papers look at IP, R&D and/or specific products being introduced.
- Measures of innovative activity:
 - Number of patents/trademarks filled by Australian firms in Australia
 - Quarterly 1994 to 2019
 - (Log) R&D spending in national accounts
 - Quarterly 1994 to 2019, excludes exploration
 - Firm-level measures of innovation from Business Characteristics Survey
 - Merged to ABS BLADE firm-level data
 - Dropped industries: public sector and administration sectors
 - We drop non employing firms and our main regressions focus on firms with at least 5 observations.

Data

What is BLADE?



Methodology

- Hard to assess relationship between innovating and MP due to endogeneity
 - CB raises rates when expect strong investment/demand, can look like higher rates stimulate innovation
- Need to find 'random' changes in MP, driven by 'non-economic' factors
 - Beckers (2020) shock measure – deviations from what would we expect the RBA to do
- Trace out response to shocks using Local Projections (Jorda 2005)

Methodology

Baseline model for Local Projections approach by Jorda (2005)

$$Inn_{i,t+h} = \beta_h shock_t + \alpha_h Inn_{i,t-1} + \sum_{j=0}^n \beta_{i,h,j} firm\ level\ controls_{i,t-j} + X_t + v_{i,t+h}$$

Controls:

X_t: Real GDP, CPI growth and trade weighted exchange rate

Firm variables (for innovation): Log of capital expenditure, log of FTE and log of turnover.

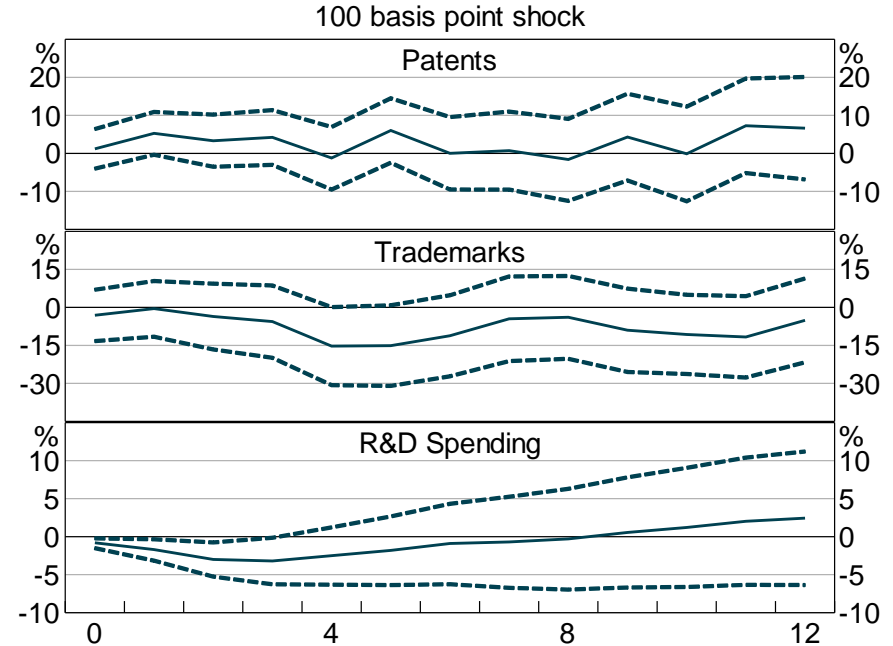
Dummies (for innovation): address affect of bi-annual survey changes

Results robust other measures of the monetary policy shock and dropping dummies for the bi-annul change.

Aggregate results

- Little effect on patenting, unlike in US
 - Consistent with tech adopter status
- Stimulates broader innovation metrics like R&D
 - Effect larger than MQ but more immediate
 - Similar results for VAR (Appendix)
 - Different identification to MQ

Effect of Monetary Policy Shock on Aggregate Innovation Metrics*



* Trademark sample excludes 1994-1995 due to apparent break in series. Patents and trademarks include only those with only Australian filers. Dashed lines show 90 per cent confidence interval.

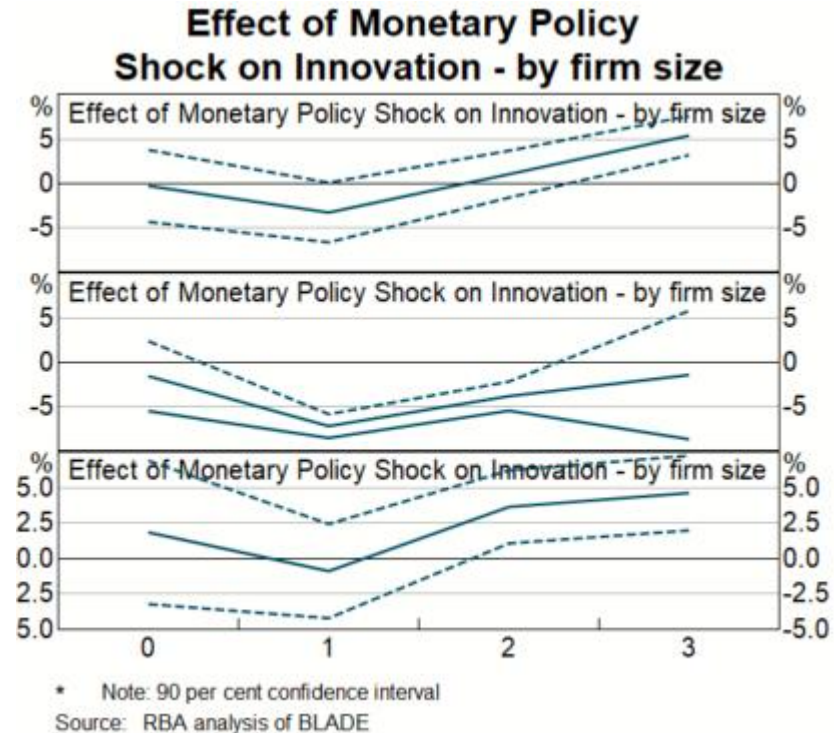
Sources: ABS; IP Australia; RBA

Results

Importantly we find varied effect by firm size

SMEs: negative

Large firms: positive



Results

How do we put these numbers into context?

- Contractionary monetary policy shock leads to around 67000 and 35000 fewer SMEs implementing innovation in years 1 and 2 after
- Around 200 more large firms undertaking innovation.
- Variation is large in context of variation in innovation share over time

Considering the channels with microdata

What are some of the potential monetary policy channels?

- Endogenous growth models, including Schumpeterian and Product Variety growth models argue that firms innovate with the expectation of capturing economic profit.
 - As profit expectations change, so does the intent to innovate. Tightening monetary policy could alter aggregate demand, thereby changing future profit expectations – potential impact: negative.
- Higher borrowing costs and credit constraint channels (the balance sheet channel) – potential impact: negative.
- Lower input costs – potential impact: positive. So I don't show it here, but firms with better management capability generally can mitigate the adverse effects of monetary policy shock.

Channels – Demand

Table 3: Impact on a firm's turnover
Log of turnover

	Year 0	Year 1	Year 2	Year 3
All Firms	-0.01	-0.05***	-0.05***	-0.03
Standard error	0.006	0.012	0.006	0.017
N	27872	22921	18207	13640
SMEs	0.02	-0.06**	-0.08**	-0.11
Standard error	0.012	0.016	0.016	0.187
N	13288	10256	7184	3939
Large firms	-0.04***	-0.04***	-0.03	-0.04**
Standard error	0.006	0.006	0.013	0.011
N	14584	12665	11023	9701

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS

Channels – Demand... exporters

Table 7: Differential impact on exporter firms
Marginal effect on all firms

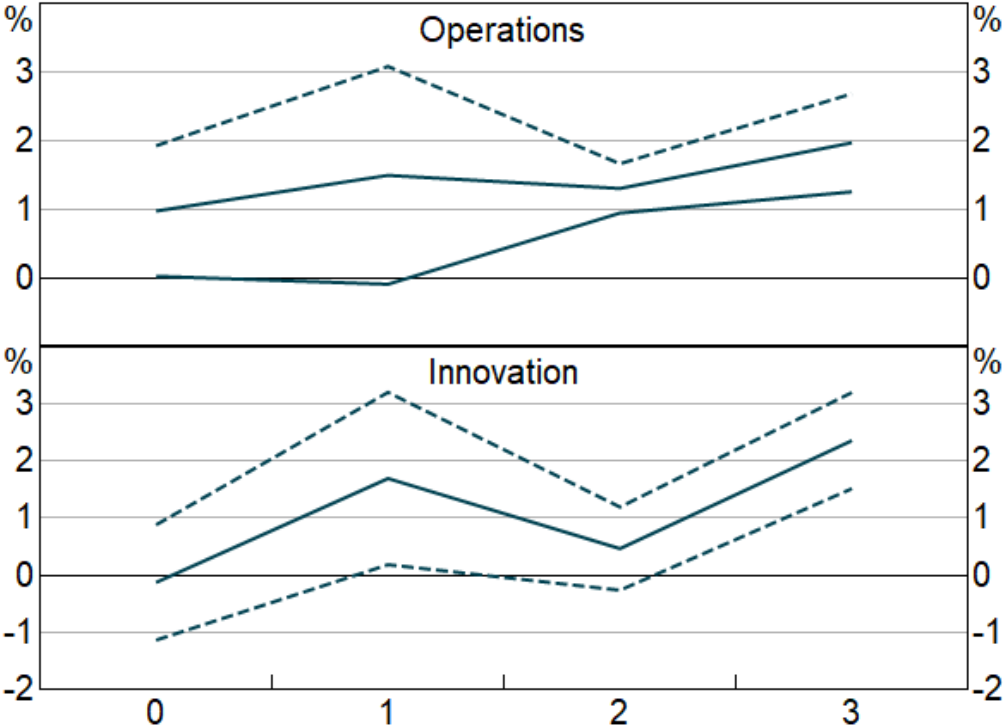
	Year 0	Year 1	Year 2	Year 3
Exporter anytime (none)	-0.01	-0.07**	-0.01	0.03
Standard error	0.034	0.029	0.026	0.031
T value	-0.20	-2.39	-0.43	1.10
Exporter anytime (Any)	0.00	0.00	0.03*	0.07
Standard error	0.029	0.019	0.017	0.019
T value	0.07	0.24	1.90	3.49
N	27810	22851	18161	13627

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS

Channels – credit constraint

Lack of funds hampering:



Results – foreign ownership

Table 4: Differential impact on firm with foreign ownership

Marginal effect on all firms

	Year 0	Year 1	Year 2	Year 3
Foreign ownership (none)	-0.03	-0.07**	-0.02	0.05*
Standard error	0.029	0.027	0.021	0.027
T value	-0.98	-2.60	-0.74	2.00
Foreign ownership (Any)	0.04	0.03	0.05*	0.05**
Standard error	0.030	0.024	0.025	0.021
T value	1.40	1.08	1.88	2.62
N	27810	22851	18161	13627

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS



Conclusions

Conclusion

- Monetary policy shocks can have implications for the real economy. This is the first paper that looks at the impact of monetary shocks on productivity inputs in Australia and firm level innovation globally.
 - Negative impact on R&D.
 - Varied impact on firms of different sizes
- Impact typically happens 1 or 2 years after the monetary policy shock.
- Heterogeneity in terms of impacts, state dependent – firm size and type.

Spares

Robustness

We have already seen some robustness tests. Some others included:

- Using other monetary policy shock variables.
- Removing FVs
- Removing contemporaneous FVs



Business focus

Table 10: Major Business focus on innovation – any level of focus

Marginal effect on all firms

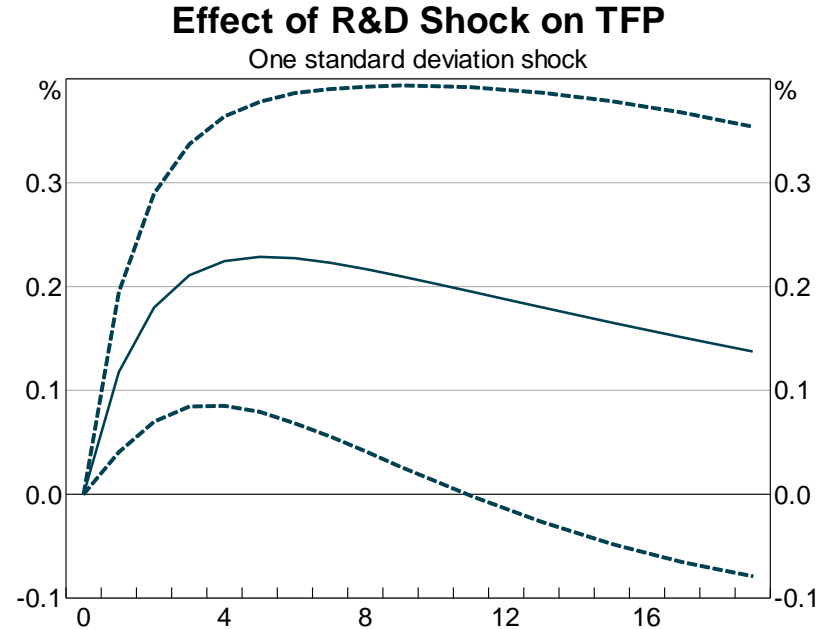
	Year 0	Year 1	Year 2	Year 3
Business focus on innovation (none)	-0.09**	-0.14**	-0.09*	0.07
Standard error	0.031	0.038	0.047	0.061
T value	-2.86	-3.68	-1.86	1.19
Business focus on innovation (Yes)	0.00	-0.02	0.02	0.06***
Standard error	0.024	0.019	0.019	0.009
T value	0.20	-1.05	1.18	6.53
N	27176	22355	17777	13383

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS

Are there implications for productivity?

- Increase in R&D leads to increase in TFP
- TFP response similar to QM, though size of R&D shock is smaller
- Still suggests similar mechanisms at work



* Response from a VAR with log level of GDP, R&D, and TFP . Response from Cholesky decomposition with R&D ordered last. VAR has 1 lag. Dash lines are 90 per cent confidence interval

Business focus

Management capability is seen as a form of technology - helping support firm performance (Bloom, Sadun and Van Reenen 2016).

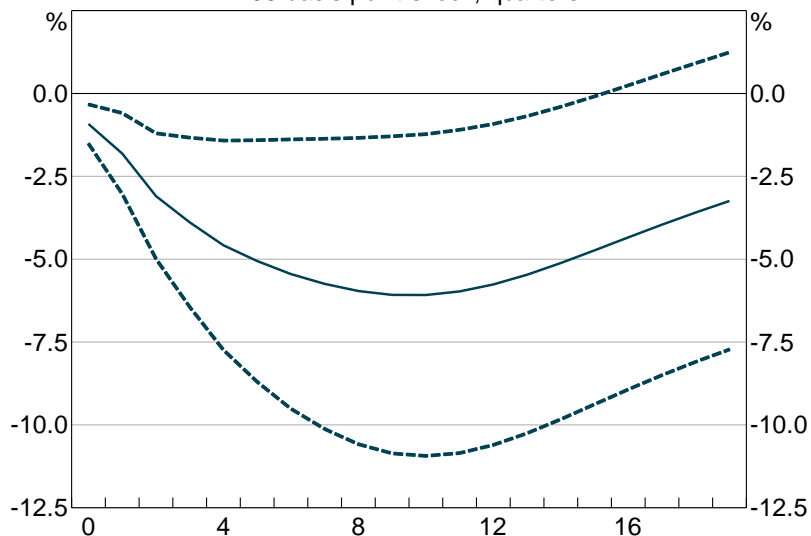
Additionally, management's focus on innovation has been shown to be significantly linked to a firm's ability to undertake higher orders of innovation and to firm growth (Majeed and Breunig 2022; Majeed et al 2021).

Management capability may help firms navigate some of the challenges created by macroeconomic and monetary policy shocks



Effect of Monetary Policy Shock on R&D Spending

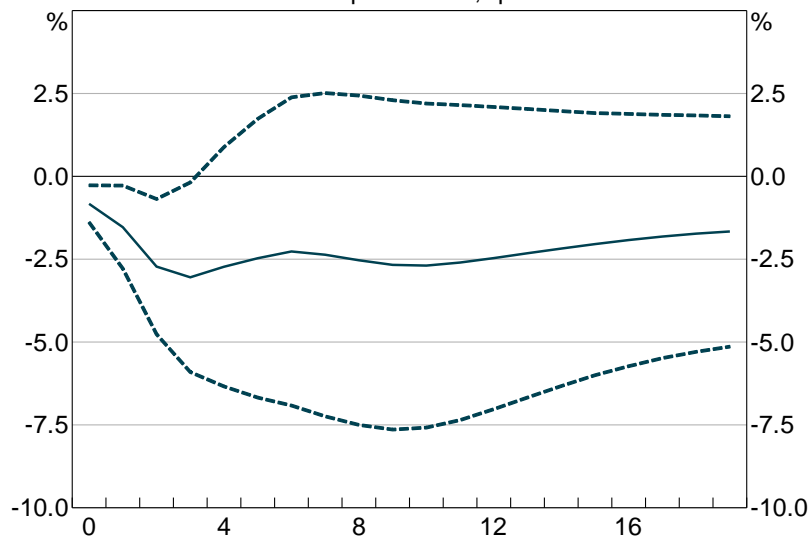
100 basis point shock, quarters



* Response from a VAR with log level of CPI, GDP, R&D, and level of cash rate and shock. Response from Cholesky decomposition with shock measure ordered first. VAR has 2 lags. Dash lines are 90 per cent confidence interval

Effect of Monetary Policy Shock on R&D Spending

100 basis point shock, quarters



* Response from a VAR with log level of CPI, GDP, R&D, and level of cash rate and shock. Response from Cholesky decomposition with shock measure ordered first. VAR has 4 lags. Dash lines are 90 per cent confidence interval

Table 8: Differential impact on exporter firms
Marginal effect on SMEs

	Year 0	Year 1	Year 2	Year 3
Exporter anytime (none)	-0.01	-0.09***	-0.04*	-0.02
Standard error	0.028	0.012	0.020	0.042
T value	-0.28	-7.03	-1.90	-0.51
Exporter anytime (Any)	-0.03	-0.03**	-0.03	0.00
Standard error	0.020	0.014	0.028	0.052
T value	-1.40	-2.31	-1.02	-0.03
N	13227	10188	7140	3927

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS

Table 9: Differential impact on exporter firms
Marginal effect on large firms

	Year 0	Year 1	Year 2	Year 3
Exporter anytime (none)	0.03	-0.04	0.02	0.02
Standard error	0.041	0.045	0.030	0.035
T value	0.68	-0.84	0.56	0.45
Exporter anytime (Any)	0.01	0.00	0.05**	0.06***
Standard error	0.031	0.030	0.019	0.018
T value	0.43	0.16	2.35	3.39
N	14583	12663	11021	9700

Note: (a) Standard errors in parentheses, ***P < 0.01; **P < 0.05; *P < 0.1. Robust standard errors used.

Source: BLADE 2022: BAS, PAYG and BCS

Motivation

R&D and innovation effort could be counter cyclical (Aghion et al 2012).

- Firms take advantage of decreasing input prices and the cost of labour to invest in innovation and future productivity growth.
- The opportunity cost of long-term innovative investments is lower when aggregate demand is low compared to times of economic booms (Bloom 2007).
- But also firms could innovate to preserve market share in an environment of low aggregate demand

Preview:

- We find evidence that on average monetary policy tightening is likely to lower the probability of innovations for SMEs. For large firms there is evidence of a positive effect.