## The Impact on Brexit on UK Firms

Nick Bloom (Stanford), Phil Bunn (Bank of England), Scarlet Chen (Stanford) Paul Mizen (Nottingham), Pawel Smietanka (Bank of England), Greg Thwaites (Bank of England)

#### Preliminary – Columbia, March 5<sup>th</sup> 2019



**Disclaimer:** Any opinions and conclusions expressed herein are those of the author and do not necessarily represent the views of the Bank of England.

# Brexit key dates

- 1. June 2016 referendum, 52% voted leave. Cameron resigned as Prime Minister, succeeded by Theresa May.
- 2. <u>Sept 2018</u> the "Chequers plan" is rejected by EU leaders in Salzburg, raising likelihood Britain leaves with no deal
- 3. <u>March 2019</u> Britain (currently) needs to leave (Article 50)

#### **BREXIT VOTER BREAKDOWN BY AGE**

### Brexit vote (demographics similar to Trump)

Supported by older, less educated, poorer, rural voters



YOUGOV SURVEY, NOT SCALED FOR POPULATION OR VOTER TURNOUT



BREXIT VOTER BREAKDOWN

#### Median annual income of residents



Source: The Guardian https://www.theguardian.com/news/datablog/2016/jun/24/the-areas-and-demographics-where-the-brexit-vote-was-won

### Following Brexit vote a Bank-Nottingham-Stanford team rapidly started a new firm survey

- Piloted survey and questions July and August 2016
- Sept 2016 rolled out randomly sampled population of all 45K UK firms with 10+ employees inviting them to join the monthly Decision Maker Panel
- So far 8K firms in the DMP





### **Key findings**

Opinions:

- A) Brexit seen by firms as an massive second moment (uncertainty) shock with added first moment impact
- B) Firms with more prior EU exposure exports, imports, workers and regulations hit with greater uncertainty

Regression results:

- A) So far...Brexit reduced employment growth by about 0.5% and investment growth by about 5%.
- B) Reduced productivity by about 1% (so far) from greater misallocation (likely negative within firm effects too)

# Estimating the impact of Brexit is not easy – growth picked up in 2016 – hence use micro data

### **Business Investment in G7 Economies**

(In percent, Q/Q growth rate, 4-quarter moving average)



### **Conceptual framework**

**Decision Maker Panel** 

**Basic Data** 

**Impact of Brexit** 

7

### **Classic "Stochastic Volatility" Uncertainty Model**

Output

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

Productivity or demand (in logs)

$$z_t = \rho z_{t-1} + \sigma_t t_t$$

Uncertainty

 $\sigma_t = \gamma \sigma_{t-1} + \lambda v_t$ 

Style of Black Scholes (1973), Dixit and Pindyck (1994), Hassler (1996) and Abel & Eberly (1996). Actual model in Bloom (2009).

### **Classic uncertainty shock drop and rebound**



Source: Bloom (2009)

### But Brexit is a "Bayesian" Uncertainty Shock (with an additional negative first moment shock)

Output

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

Productivity or demand (in logs)

$$z_t = \rho z_{t-1} + \sigma_{t-s} \varepsilon_t$$

Uncertainty

$$\sigma_t = \gamma \sigma_{t-1} + \lambda v_t$$

Style of Bernanke (1983)

**Conceptual framework** 

**Decision Maker Panel** 

**Basic Data** 

Impact of Brexit

### Firms are recruited from a Nottingham call center





#### **Decision Maker Panel (September 2018)**

1.

In the second quarter of 2018 (April to June), what was the approximate sterling value of your SALES REVENUE (in £ THOUSANDS)?

Notes:

a) Please reply to two significant figures (eg. 15 [thousand], 150 [thousand], 1500 [thousand]).

b) For businesses that finance themselves mainly from grants or donations, rather than sales, please provide figures from those sources instead.

c) Please include sales of UK-based businesses only and not from any overseas part of the group.

£'000	250
Back	Next
Dack	INEXT

September 2018 – SALES AND PRICES



#### **Decision Maker Panel (September 2018)**

2. Looking back over the past year, by what % amount has your SALES REVENUE <u>changed</u> since the same quarter a year ago (April to June 2017)?	
5.0 %	]
Back Next	

September 2018 – SALES AND PRICES



#### **Decision Maker Panel (September 2018)**

3. Looking a year ahead from the second quarter of 2018 to the second quarter of 2019, by what % amount do you expect your SALES REVENUE to have <u>changed</u> in each of the following scenarios?

The LOWEST % change in sales revenue would be about:	0.0 %	
A LOW % change in sales revenue would be about:	3.0 %	
A MIDDLE % change in sales revenue would be about:	5.0 %	
A HIGH % change in sales revenue would be about:	7.0 %	
The HIGHEST % change in sales revenue would be about:	10.0 %	

Back

Next

September 2018 – SALES AND PRICES

Page 5 of 12



#### **Decision Maker Panel (September 2018)**

4. Please assign a percentage likelihood (probability) to the % <u>changes</u> in SALES REVENUE you entered (values should sum to 100).

LOWEST: The likelihood of realising about 0.0 % would be:	10	
LOW: The likelihood of realising about 3.0 % would be:	20	
MIDDLE: The likelihood of realising about 5.0 % would be:	40	
HIGH: The likelihood of realising about 7.0 % would be	20	
HIGHEST: The likelihood of realising about 10.0 % would be:	10	
Total	100	



September 2018 - SALES AND PRICES

#### Data quality looks good – for example, uncertainty and forecast errors Sales **Employment** Capex log of error in realized capex growth 3 3.5 4 4.5 log of error in realized emp growth 0 1 2 3 growth 4 of error in realized sales bo 3.5 1.5 2.5 3.5 5 -.5 1.5 2.5 5 2 3 4 .5 -.5 log uncertainty in expected emp growt log uncertainty in expected capex grow log uncertainty in expected sales growth **Price** Cost of error in realized price growth. -2 -1. 0. 1. 2. log of error in realized cost growth -1.5.-1.-5.0.5.1.1.5. Note: Uncertainty subjective defined as uncertainty from the DMP 5-bin responses. Forecast errors defined |forecast-actual| as growth the over ) bo following 12 month -1.5 -1 -.5 0 .5 1.5 -1.5 -1 -.5 1.5 2 2 0 .5 period

log uncertainty in expected price growt

log uncertainty in expected cost growth.

## **DMP** sample size



# DMP broadly matches the pattern in the UK Business Register

Percentage of employment

Manufacturing Construction Wholesale & Retail Transport & Info. Accom. & Food Real Estate Prof. & Admin. Human Health Other services



# The majority of DMP respondents are finance directors or senior managers

Percentage of respondents



### These CEOs and CFOs are more negative on Brexit than the general population



**Source**: Question "*What is your overall view of Brexit?*". "DMP" is the Decision Maker Panel survey of CEOS and senior managers. "nmg" is a national voter survey

## So check response in frame (all 10+ employee firms) is uncorrelated with local Brexit vote share

	Ever respond to a survey if in the sampling frame						
	(1)	(2)	(3)	(4)			
Leave vote share	-0.002	-0.004	0.002	0.002			
	(0.015)	(0.015)	(0.015)	(0.015)			
Log of employment		0.014***	0.008***	0.008***			
		(0.001)	(0.002)	(0.002)			
Log of sales			0.003	0.003			
			(0.002)	(0.002)			
Log of assets			0.003*	0.003*			
			(0.002)	(0.002)			
Latest real sales growth				0.000			
				(0.000)			
Latest profit margin				-0.000			
				(0.000)			
Observations	39,757	39,757	39,757	39,757			
R-squared	0.076	0.079	0.079	0.079			

Robust standard errors in parentheses

## Data quality looks good – for example, comparing DMP to Company Accounts



### Data quality looks good – macro aggregates





**Decision Maker Panel** 

**Basic Data** 

Impact of Brexit

### Uncertainty over when (and if) Brexit will happen

Average probability (per cent)



Question: "When do you expect the UK to leave the EU?"

### **Uncertainty over costs and revenues**

Question: "How much has the result of the EU-referendum impacted the level of uncertainty affecting your business?"



### Uncertainty is also rising over time



Question: "How much has the result of the EU-referendum impacted the level of uncertainty affecting your business overall?"

### **Uncertainty jumped in particular in Sept 2018**



# Interestingly do not see this in realized/news uncertainty measures (Brexit as a Bayesian shock?)

Standard deviations from average since 1997



'Stock market volatility' measure is FTSE all-share three-month option implied volatility. 'Policy uncertainty index' is constructed based on newspaper articles regarding policy uncertainty in The FT, The Sunday Times, The Telegraph, The Daily Mail, The Daily Express, The Times, The Guardian, The Mirror, The Northern Echo, The Evening Standard, and The Sun.

## Brexit uncertainty by firm size and region



**Note**: The question asked 'How much has the result of the EU referendum affected the level of uncertainty affecting your business?'.

**Note**: The question asked 'How much has the result of the EU referendum affected the level of uncertainty affecting your business?'.

**Decision Maker Panel** 

**Basic Data** 

**Impact of Brexit** 

## Brexit was a shock – so we can also use a classic difference in differences estimation...



Source: oddschecker.com, University of Stirling Management School and Centre on Constitutional Change

## ...by using Pre-Brexit (2016H1) EU exposure

#### Shares of sales that are exports to EU



Shares of workforce who are EU migrants

40
40
30
20
10
51%
6-10%
11-20%
>20%

Percentage of panel members

#### Shares of costs that are imports from EU



#### Shares of sales covered by EU regulations



Percentage of panel members

# Firms' pre-Brexit (2016H1) EU exposure predicts the Brexit uncertainty increase extremely well

		Uncertainty			
	(1)	(2)	(3)	(4)	(5)
VARIABLES					
Share exports to EU	0.459***				0.235***
	(0.0492)				(0.0484)
Share imports from EU		0.458***			0.283***
		(0.0541)			(0.0530)
Migrant labour from EU			0.128***		0.101***
			(0.0139)		(0.0134)
EU regulations dummy				0.261***	0.203***
				(0.0213)	(0.0211)
Constant	2.296***	2.303***	2.111***	2.231***	1.902***
	(0.0219)	(0.0213)	(0.0375)	(0.0275)	<mark>(0.0406)</mark>
	2 65 9	2 650	2 650	2 650	2 650
Observations	2,658	2,658	2,658	2,658	2,658
R-squared	0.041	0.039	0.040	0.079	0.137

#### Robust standard errors in parentheses

Note: Uncertainty measured as the response to the question '*How much has the result of the EU referendum affected the level of uncertainty affecting your business?*' where "Not important"=1, "One of many sources"=2, "Top 2 or 3 factors"=3 and "Top factor"=4.

### (1) Brexit has reduced investment and hiring

	Investment Growth						<b>Employment Growth</b>	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DHS	DHS	DHS	DHS	DHS	DHS	DHS	DHS
uncertainty*year 1 after referendum	-4.570**					-0.627		
	(1.889)					(0.401)		
uncertainty*year 2 after referendum	-0.720					-0.720*		
	(1.793)					(0.371)		
uncertainty*year 3 after referendum	-5.559***					-0.164		
	(1.630)					(0.291)		
predicted uncertainty*year 1 after referendum		-7.333*						
		(4.035)						
predicted uncertainty*year 2 after referendum		4.563						
		(3.879)						
predicted uncertainty*year 3 after referendum		-9.587***						
		(3.333)						
predicted uncertainty* all years			-5.235**		-4.543*		-0.390	-0.0226
			(2.543)		(2.615)		(0.515)	(0.531)
survey eventual sales impact* all years				0.472*	0.385			0.183***
				(0.246)	(0.252)			(0.0568)
Observations	13,321	13,321	13,321	13,321	13,321	25,561	25,561	25,561
R-squared	0.237	0.237	0.236	0.236	0.237	0.279	0.279	0.280

**Note:** Post Brexit data from Decision Maker Panel combined with pre-Brexit data from Amadeus. All regressions include a data source dummy. Brexit uncertainty defined as a 1 to 4 variable from 1 ("no Brexit uncertainty") to 4 ("Brexit largest source of uncertainty"). Post Brexit defined as 2016 Q3 onwards

### Magnitudes roughly match UK macro data

Percentage change on a year earlier



Source: ONS national accounts data

## (2) Misallocation: More productive firms perceive a greater increase in uncertainty



Note: Uncertainty measured as the response to the question '*How much has the result of the EU referendum affected the level of uncertainty affecting your business?*' where "Not important"=1, "One of many sources"=2, "Top 2 or 3 factors"=3 and "Top factor"=4. Productivity based on 2013-2015 pre-Brexit average.

# Productive firms are more exposed to Brexit uncertainty via EU trade, regulation and migrants

	(1)	(2)	(3)	(4)	(5)		
VARIABLES	Brexit Uncertainty						
Productivity	0.185***	0.149***	0.179***	0.155***	0.132***		
	(0.0311)	(0.0303)	(0.0307)	(0.0302)	(0.0297)		
Share exports to EU		0.412***			0.266***		
		(0.0565)			(0.0550)		
Share imports from EU		0.315***			0.250***		
		<b>(</b> 0.0621)			(0.0601)		
Migrant labour from EU			0.119***		0.0897***		
			(0.0158)		(0.0152)		
EU regulations dummy				0.267***	0.210***		
				(0.0233)	(0.0235)		
Observations	2.658	2.658	2.658	2.658	2.658		
R-squared	0.021	0.087	0.055	0.106	0.159		

#### Robust standard errors in parentheses

Note: Uncertainty measured as the response to the question '*How much has the result of the EU referendum affected the level of uncertainty affecting your business?*' where "Not important"=1, "One of many sources"=2, "Top 2 or 3 factors"=3 and "Top factor"=4.

## Find productive firms cut investment and sales more – overall impact about -1% on TFP growth

	(1)	(3)	(4)	(5)	(6)
VARIABLES		Сарех	(/Sales		Sales Growth
Productivity	0.0116***	0.0132***	0.0132***		
	(0.00235)	(0.00236)	(0.00236)		
Productivity * Post		-0.0103**	-0.0104**	-0.0104**	-0.0975**
		(0.00503)	(0.00502)	(0.00465)	(0.0399)
Year FE			Y	Y	Y
Firm FE				Y	Y
Observations	18,679	18,679	18,679	18,679	15,483
R-squared	0.027	0.027	0.028	0.486	0.346

Robust standard errors in parentheses

**Note:** Productivity measured using 2013-2015 average labor productivity from company accounts. Predicted productivity is the value predicted by firms import, export, EU employee and multinational characteristics. "Post" is post-Brexit.

## Can use the impact of Brexit on firms long-run growth to estimate TFP impact: ≈1% lower growth

Dependent variable: Firms' expected eventual impact of Brexit on sales (%), two-part fitted normal approach	(1)	(2)	(3)	(4)	(5)	(6)
Pre referendum characteristics:						
Log labour productivity (2013-15 average)	-0.682***	-0.634***	-0.669***	-0.640***	-0.574***	-0.525**
	(0.228)	(0.226)	(0.225)	(0.222)	(0.218)	(0.212)
Share of exports to EU		-1.388***				-0.772**
Share of imports from EU		(0.070)	-1.178***			-0.683**
			(0.334)			(0.335)
Migrant labour from EU				-0.491***		-0.395***
				(0.107)		(0.107)
EU regulations dummy					-0.868***	-0.718***
					(0.136)	(0.135)
3 digit industry dummies	Y	Y	Y	Y	Y	Y
Time dummies	Y	Y	Y	Y	Y	Y
Log employment (2013-2015 average)	Y	Y	Y	Y	Y	Y
Pre-Brexit real sales growth (2013-2015 average)	Y	Y	Y	Y	Y	Y
Observations	3,925	3,925	3,925	3,925	3,925	3,925
R-squared	0.133	0.141	0.140	0.145	0.154	0.169

**Note:** Labor productivity measured using 2013-2015 average labor productivity from company accounts.

### Finally, also likely a within firm TFP impact - e.g.

Table 1 Number of hours a week spent on preparing for Brexit (share).

	CEO	CFO
None	41%	38%
Up to 1 hour	37%	39%
1 to 5 hours	14%	18%
6 to 10 hours	3%	3%
More than 10 hours	1%	1%
Don't know	4%	2%

### **Conclusions: Key findings**

Opinions:

- A) Brexit seen by most firms as large negative first moment shock and second moment (uncertainty) shock
- B) Firms with more exports, imports, more EU workers and multinationals reported more negative impact

Regression results:

- A) Brexit reduced employment growth by about 0.8% and investment by about 5%.
- B) Reduced productivity by about 0.5% (so far) from greater misallocation (likely negative within firm effects too)