Breaking Borders: The Impact of Knowledge Diffusion on Gains from Trade

Zoe Zhang

University of Warwick

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- I argue that ignoring firm heterogeneity and their interaction with knowledge diffusion leads to a significant **underestimation** of the gains from trade.
- Moreover, trade liberalisation events have a persistent impact on economic growth and thus national welfare.

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- (3) Trading firms cite more foreign patents, and there is a positive correlation between total citations and total trade values.
- (4) Foreign technology adoption fees account for a large share of Chinese firms' technical expenditures.

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  2. **adopt** foreign technologies to reduce production costs.
- I show ignoring knowledge diffusion and its impact on trade margins significantly underestimates the gains from trade.

Data and stylised facts

Data

1. I collect national expenditures on **foreign technology imports** from China Science and Technology Statistics Yearbooks.
2. I use the Chinese industrial enterprise database to estimate **firm-level TFP** via Wooldridge (2009):
   - Balance sheet data
   - All industrial firms with sales above 5 million RMB.
   - These firms comprise more than 95% of total industrial output and 98% of industrial exports.
3. I collect **customs data** from the general administration of Customs People's Republic of China:
   - All trading firms' trade value, content, trading partner etc.
4. I collect all **firm-level patent applications and citation** in China from He et al., 2018, PatSnap and other economies' patent stocks from the USPTO.

$\rightarrow$ Merging those datasets leads to 1.5 million observations.

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3. Knowledge diffusion, measured by citation, is positively correlated with trade value and new patent applications.
   Trading firms, especially importers, cite more patents on average.
4. Foreign technology adoption is important for Chinese firms. Adoption fees were, on average, around 60% of domestic R&D from 1998 to 2007.

Theoretical Model

Model set up

- There are N countries, J sectors. Household's problem is standard.
- Before production, firms draw productivity z_i^j from a Pareto distribution

$$F(z) = T_i^j (z_i^j)^{-\theta^j},$$

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- Firms can decide whether to export or not.
- There is a fixed cost f_{ni}^j for country i to serve the foreign market n.
- Entering the foreign market gives access to better technology, which reduces the marginal cost of production by $\zeta_{ni}^j \geq 1$.

Knowledge diffusion

- The productivity level of an idea depends on two parts, $Z = hZ'^{\rho^j}$.
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- **Own innovation:** h captures the innovator's own idea.
- **Learning from sellers:** Z' is the insight drawn from another producer.
- The growth of knowledge stock is given by

$$T^j_{i,t+1} = T^j_{i,t} + m^j_t \Gamma(1-\rho^j) \left[\sum_{n=1}^{N} \pi^j_{int} \left(T^j_{n,t} \right)^{\rho^j} \right], \qquad (1)$$

  m^j_t: mean of the idea generation process, $\Gamma(.)$: Gamma function, ρ^j: diffusion parameter.
- π^j_{in}: expenditure of country i spends on n in sector j. Endogenously determined in equilibrium.

Technology adoption

- I assume the reduction in marginal cost ζ_{ni}^{j} is determined by a weighted sum of domestic and foreign knowledge stocks,

$$\zeta_{ni}^{j} = (\Delta^{j} T_{n}^{j} + (1 - \Delta^{j}) T_{i}^{j}).$$

- When country i exports to n, it gains a fraction of knowledge from n.
- Trade with countries with higher knowledge stock leads to a higher reduction in domestic production cost per unit

$$\frac{c_{i}^{j}}{\zeta_{ni}^{j} z_{i}^{j}}.$$

Comparison with the standard model

- A symmetric two-country model with the only difference being the initial knowledge stock, $T_{1,t=0} < T_{2,t=0}$.
- Trade is balanced in every period.
- Suppose there is a 10% reduction in bilateral trade costs in period 5.

Comparison with the standard model

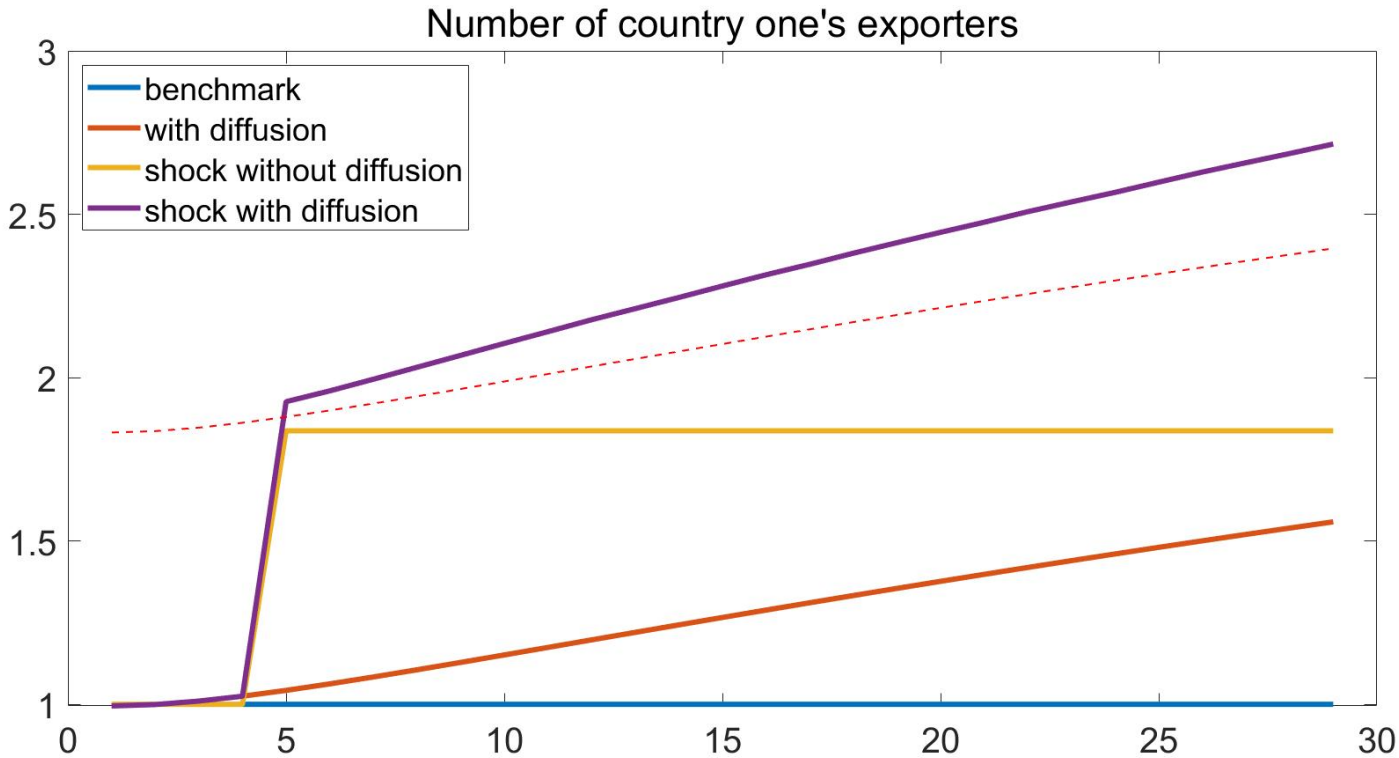


Figure 1: Changes in the number of exporters of country one (low T_0), when there is a reduction in bilateral trade cost at period five.

Comparison with the standard model

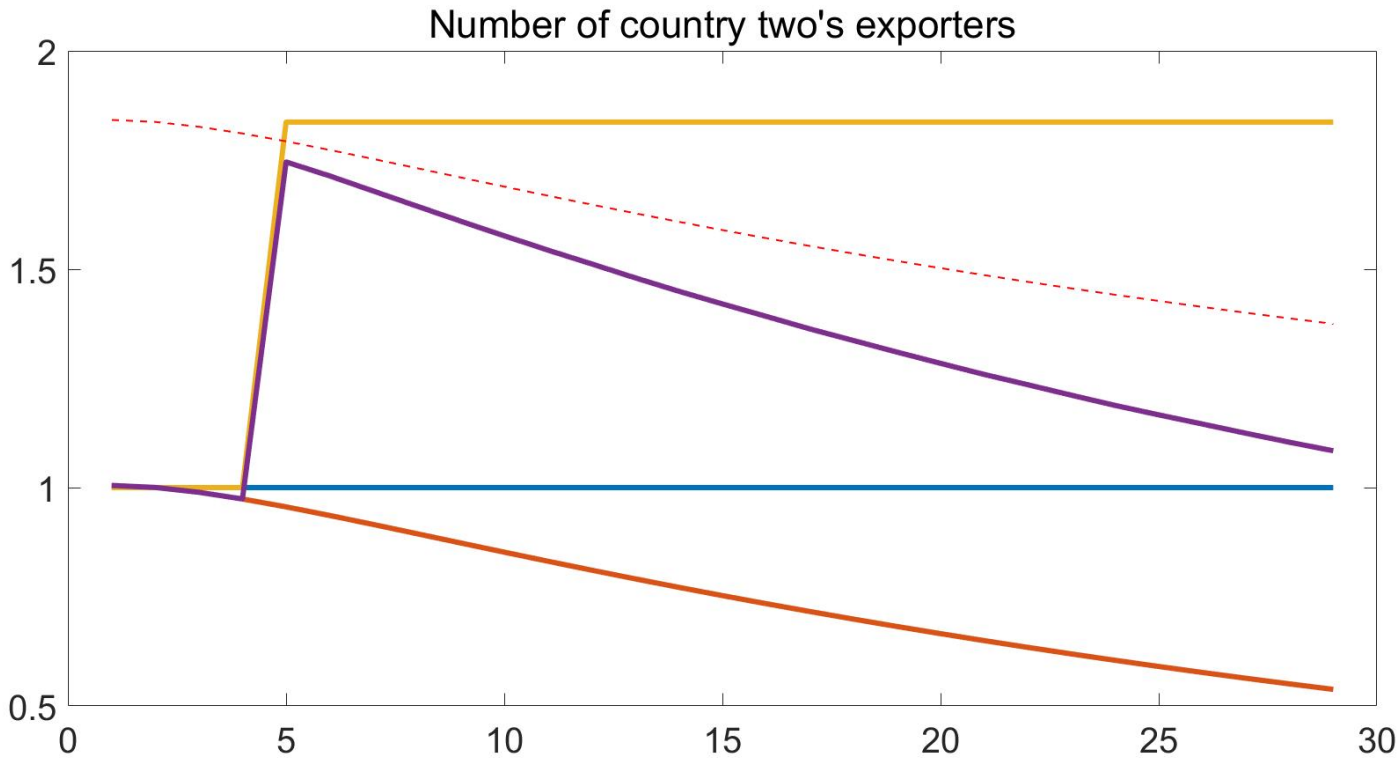
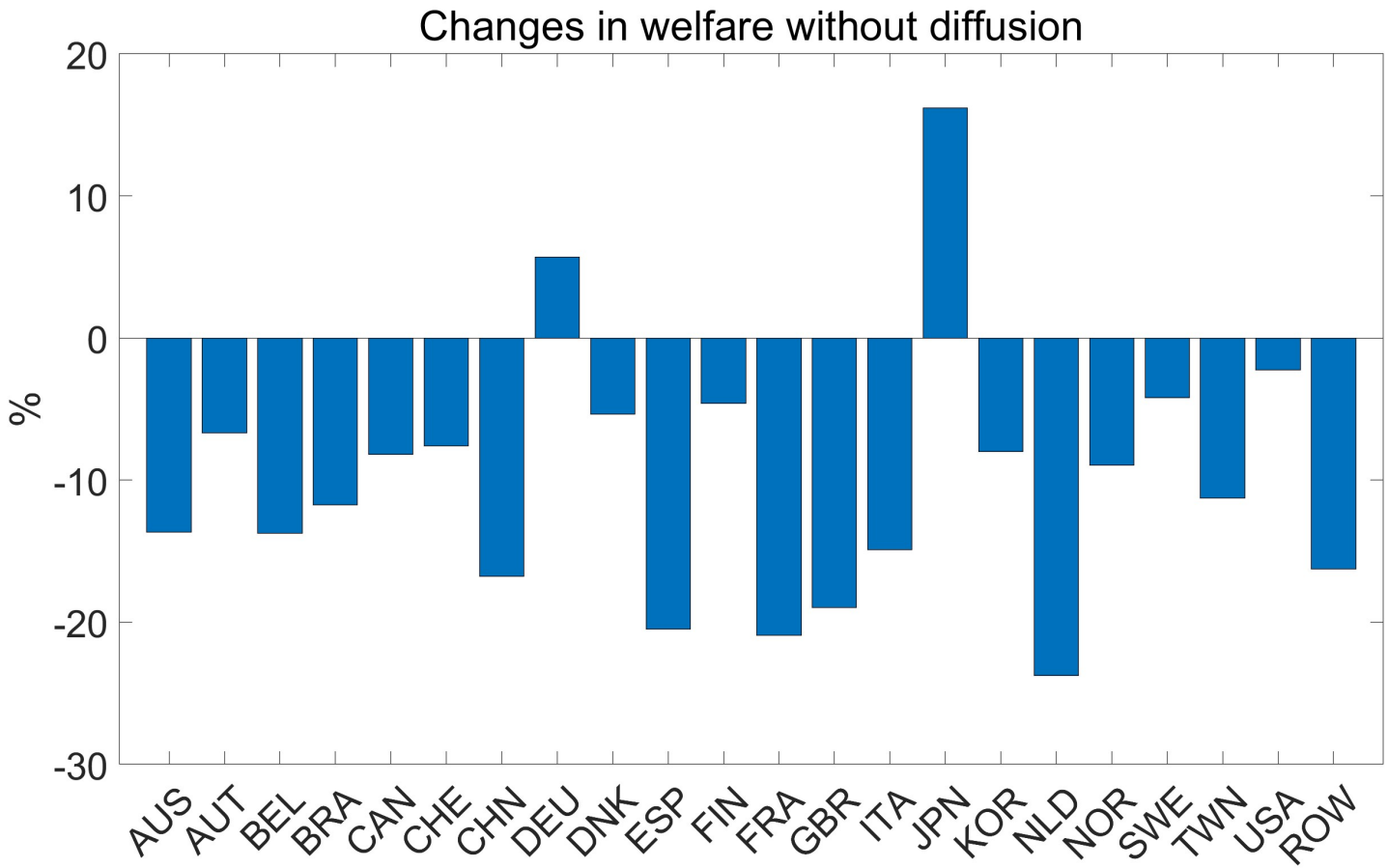


Figure 2: Changes in the number of exporters of country two (high T_0), when there is a reduction in bilateral trade cost at period five.

Counterfactuals

Counterfactual 1: Welfare without difffusion

Assuming there was no knowledge diffusion over the sample period, what would happen to welfare?



Counterfactual 1: Exporting productivity threshold

In most economies, diffusion leads less productive firms to export.

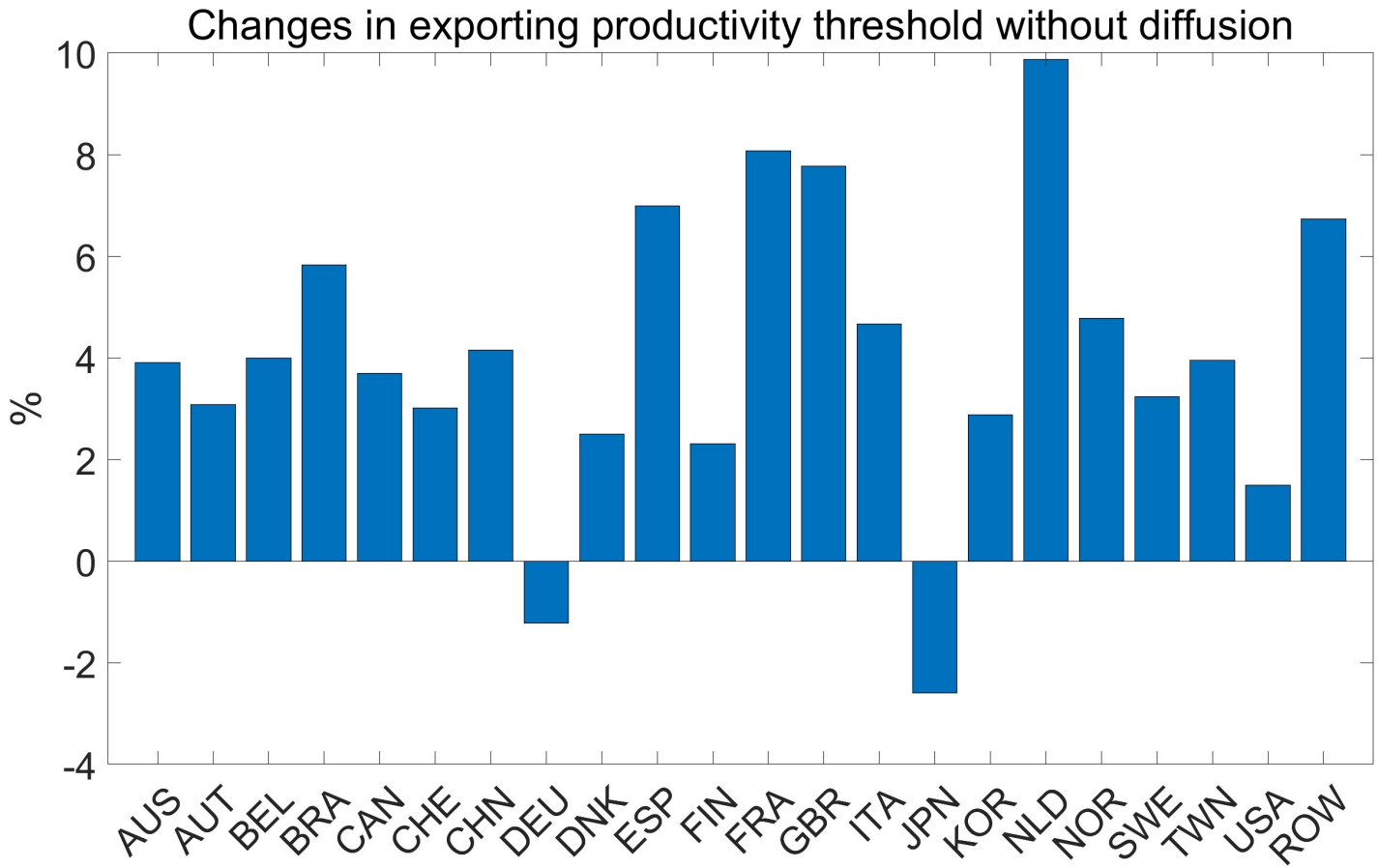


Figure 3: Changes in national extensive margin if there was no diffusion

Counterfactual 1: Sales per exporter

In most economies, diffusion leads each exporter to export more.

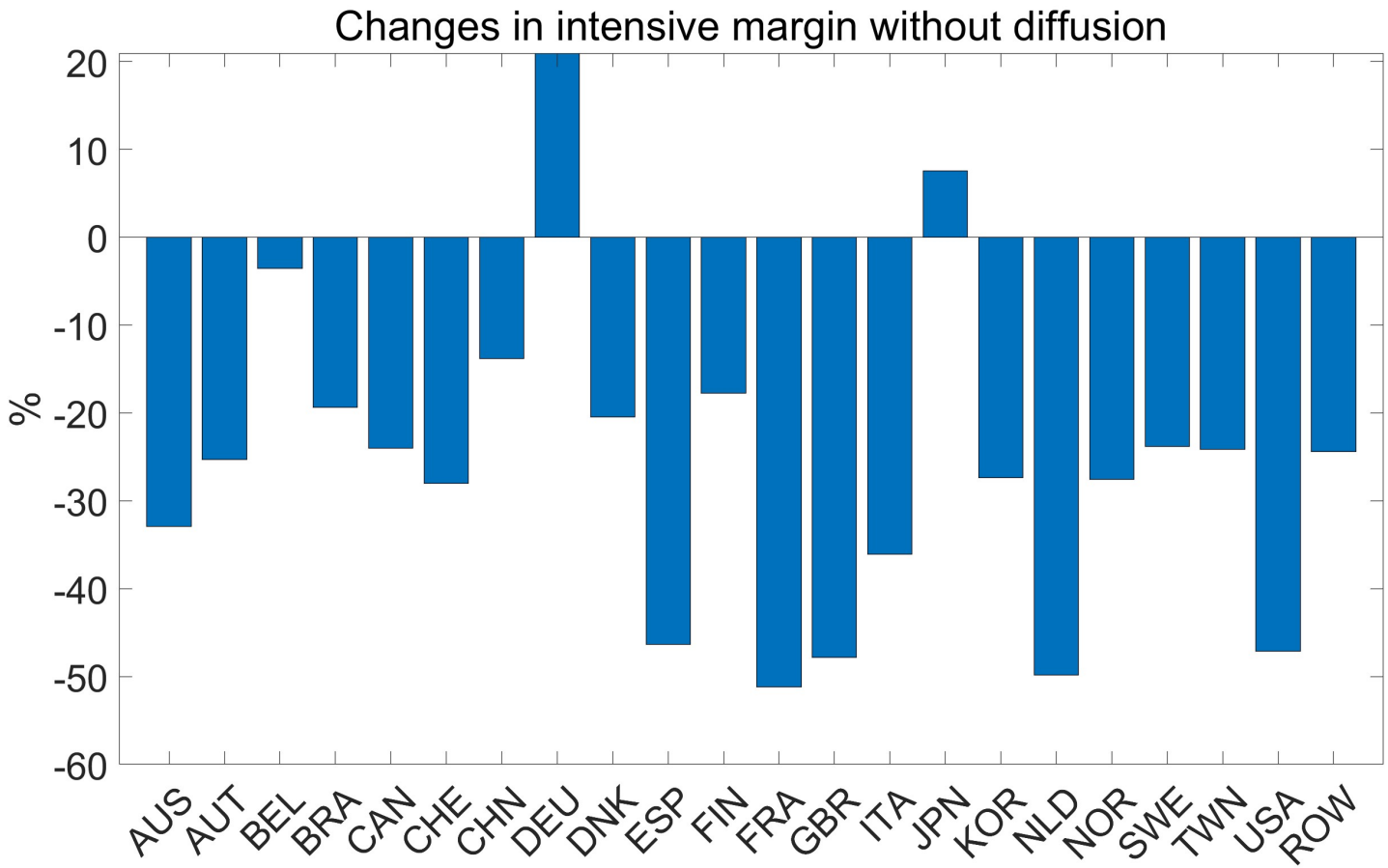


Figure 4: Changes in national intensive margin if there was no diffusion

Counterfactual 2: Without China's WTO accession (exogenous trade balance)

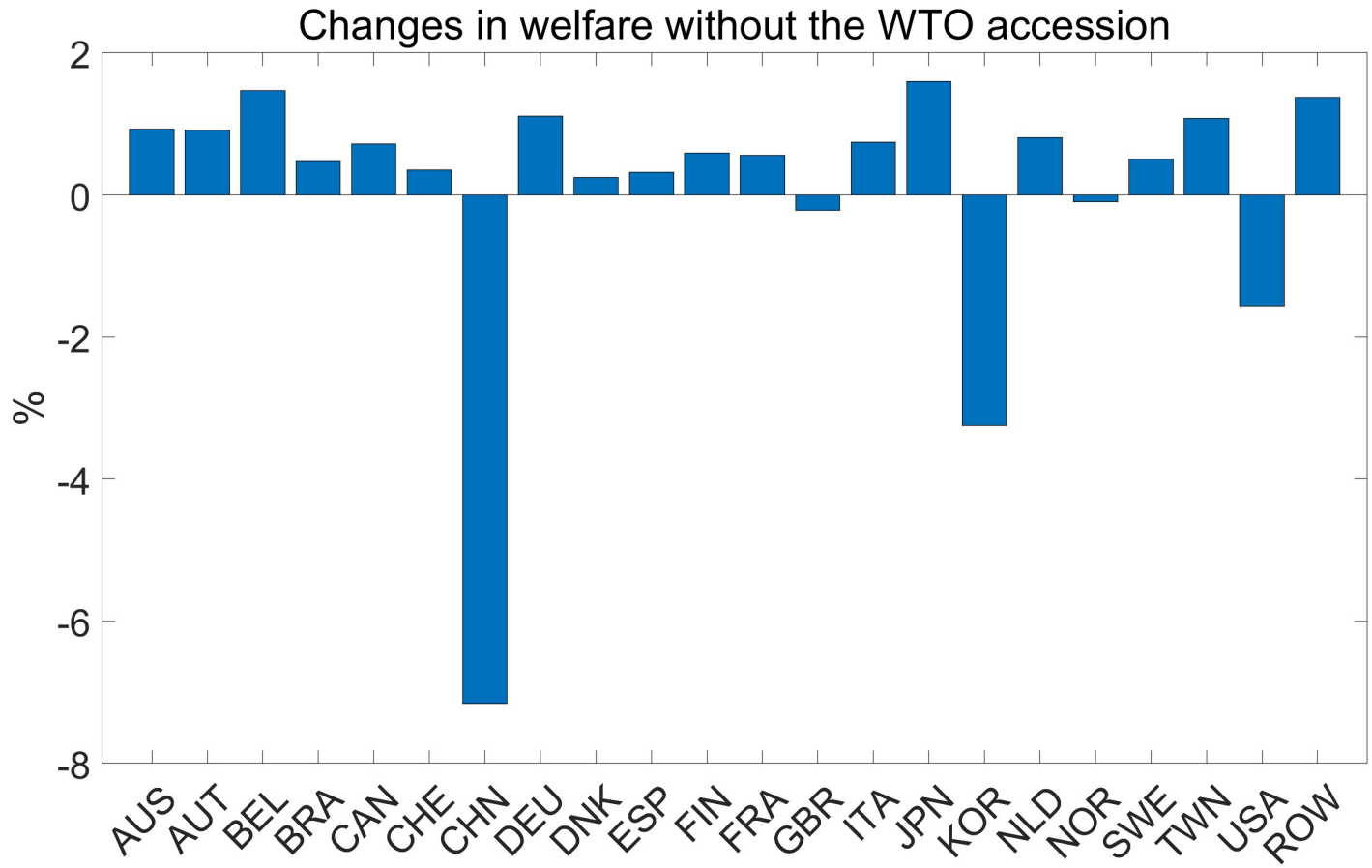


Figure 5: Changes in welfare without China's WTO accession

Changes in welfare with and without diffusion

	With diffusion	Without diffusion
AUS	0.93%	0.14%
AUT	0.91%	0.36%
BEL	1.47%	0.45%
BRA	0.47%	0.25%
CAN	0.72%	-0.48%
CHE	0.35%	0.41%
CHN	-7.16%	-0.43%
DEU	1.11%	1.33%
DNK	0.25%	0.25%
ESP	0.32%	0.49%
FIN	0.59%	0.53%
FRA	0.56%	0.45%
GBR	-0.21%	0.29%
ITA	0.74%	0.20%
JPN	1.59%	0.75%
KOR	-3.25%	0.60%
NLD	0.81%	0.52%
NOR	-0.09%	0.67%
SWE	0.50%	0.25%
TWN	1.08%	-0.01%
USA	-1.57%	-1.64%
ROW	1.37%	0.15%

Conclusion

- I use Chinese firm-level data to show that knowledge diffusion is closely related to trade.
- I write a general-equilibrium model with knowledge diffusion and technology adoption to study the impact of trade liberalisation on gains from trade.
- I find the dynamic model has different implications than the standard trade model.

Literature Review (1)

- **Firm-level trade, innovation and growth:** Aw, Roberts, and Xu, 2011, Lileeva and Trefler, 2010, Bloom, Draca, and Van Reenen, 2016, Aghion et al., 2022 and Bustos, 2011.
- I differ from them by studying the general equilibrium effect with endogenised changes in trade margins.
- **Trade models with knowledge diffusion:** Buera and Oberfield, 2020,Cai et al., 2022,Cai, Li, and Santacreu, 2022
- I study the response of firms due to knowledge diffusion and changes in trade costs.
- **Gains from trade:** Broda and Weinstein, 2006, Fajgelbaum and Khandelwal, 2016, Sampson, 2016, Perla, Tonetti, and Waugh, 2021
- I focus on the dynamic gains from international knowledge diffusion.

Literature Review (2)

- **Impact of trade liberalisation:** Dix-Carneiro, 2014 and Dix-Carneiro and Kovak, 2017, Topalova and Khandelwal, 2011, Caliendo and Parro, 2015, Baldwin and Forslid, 2010, Shu and Steinwender, 2019
- My work examines how knowledge diffusion shapes the results.
- **WTO and China's rise**: Yu, 2015, Brandt et al., 2017, Lu and Yu, 2015, David, Dorn, and Hanson, 2013, Asquith et al., 2019, Fajgelbaum et al., 2020, Caliendo, Dvorkin, and Parro, 2019.
- I show how the interaction between international trade and diffusion impacts global welfare.