Collateral Shocks: A Dominant Source of U.S. Business Cycles?*

Mamoon Kader† Hashmat Khan‡

October 14, 2024

Abstract

We show that the evidence is not strong enough to conclude that collateral shocks have been a *dominant* source of U.S. business cycles. Collateral shocks, as described in Becard and Gauthier (2022), which tighten bank lending standards for both households and firms, account for only 7 percent of the cyclical variation in output, and 1 percent of consumption, over the period from 1985:Q1 to 2009:Q3. During this time, lending standards for both households and firms were the most closely aligned in the data. Through counterfactual exercises, we isolate the role of estimated collateral shocks and model parameters to explain the findings.

Keywords: collateral shocks, bank lending standards, output, consumption

JEL Codes: E21, E23, E24, E32, E44

*We thank Yvan Becard, Jonathan Créchet, Simon Gilchrist, Heejeong Kim, Minjoon Lee, and Raul Razo-Garcia for their comments.

†Department of Economics, Carleton University, *E-mail:* mamoonkader@cmail.carleton.ca

‡Department of Economics, Carleton University, *E-mail:* hashmat.khan@carleton.ca

1 Introduction

In modern macroeconomic models, the role financial frictions—stemming from either information or commitment problems in financial markets—play in amplifying and propagating non-financial shocks to the economy has been a key area of study since the early contributions of Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), and Kiyotaki and Moore (1997).[1] But in the aftermath of the subprime mortgage crisis of 2007 and the prolonged U.S. recession that followed, the possibility that financial shocks can themselves be primary drivers of business cycles has received much attention. Recent research has proposed a variety of financial shocks and studied their quantitative importance in accounting for the key features of the U.S. business cycle, but the results have turned out to be only partially successful.[2] One pervasive challenge that has emerged in the literature is that in the models, financial shocks do not adequately account for the behaviour of consumption. In particular, financial shocks account for only a small share of consumption variation over the business cycle, and they do not generate consumption-output comovement—a key property of the data.[3]

In light of these issues, Becard and Gauthier (2022) have proposed a single financial shock, which they call the *collateral* shock, to resolve the two issues about the behaviour of consumption highlighted above. The collateral shock captures changes in risk or sentiment in the financial markets that affect bank lending standards for households and firms simultaneously—an essential ingredient in the model—through their respective collateral constraints. Specifically, the shock reflects the costs associated with redeploying fore-

[1] For a comprehensive survey of this literature, see Bernanke, Gertler and Gilchrist (1999) and Quadrini (2011).

[2] See, for example, Andrea Gerali, Stefano Neri, Luca Sessa and Federico M. Signoretti (2010), Jermann and Quadrini (2012), Liu, Wang and Zha (2013), Christiano, Motto and Rostagno (2014), Ajello (2016), Iacoviello (2015), Marco Del Negro, Gauti Eggertsson, Andrea Ferrero and Nobuhiro Kiyotaki (2017), and Kharazi (2022). An exception is Drechsel (2023) who finds that financial shocks do not contribute much to output growth either under collateral or earnings-based constraints, respectively.

[3] For example, the financial shock in Jermann and Quadrini (2012) that accounts for 46.4 percent of output variation, accounts for only 0.6 percent of consumption variation, and does not generate procyclical consumption.

closed assets. In their estimated model, the collateral shock competes with other shocks, namely, technology, investment, household (preference, housing, and redeployment of housing capital), firm (equity and redeployment of physical capital), and policy, and turns out to be the dominant one among all these shocks. Over the 1985:Q1-2019:Q1 period, the collateral shock accounts for a large share of business cycle variation in the key macroeconomic variables, namely, output (45 percent), consumption (41 percent), investment (43 percent), and hours (34 percent). The collateral shock also generates a strong comovement of consumption with output that is consistent with the data.

In this paper, we revisit the quantitative properties of the estimated collateral shocks. Our starting point is the observation that the net percentage of banks' lending standards tightened sharply for *both* households and firms only at the onset of the Great Recession (Figure 1). In fact, after 2014, the lending standards for households have remained persistently stable, with the net percentage in the negative range most of the time, reflecting loosening standards. Another way to see this point is that while the correlation between the two lending standards for the whole period is 0.71, the correlation is 0.70 for 1990:Q3-2009:Q3, and -0.19 for 2010:Q1-2019:Q1. It is unclear, therefore, whether the dominance of the collateral shocks arises primarily due to the specific episode of financial stringency when the standards tightened for both households and businesses or whether it is a more general phenomenon. We re-examine the quantitative importance of collateral shocks and reach some rather surprising conclusions that challenge the contemporary view of the dominance of such shocks.

We estimate the Becard and Gauthier (2022) model for the period 1985:Q1–2009:Q3. Our findings reveal that collateral shocks account for only 7 percent of the variation in output. Consequently, these shocks are not a dominant source of fluctuations in U.S. output over the 1985:Q1 to 2009:Q3 period. The collateral shock accounts for 1 percent of the variation in consumption, a sharp drop from 41 percent for the 1985:Q1-2019:Q1 period. The comovement of consumption and output, after a collateral shock, is also substantially

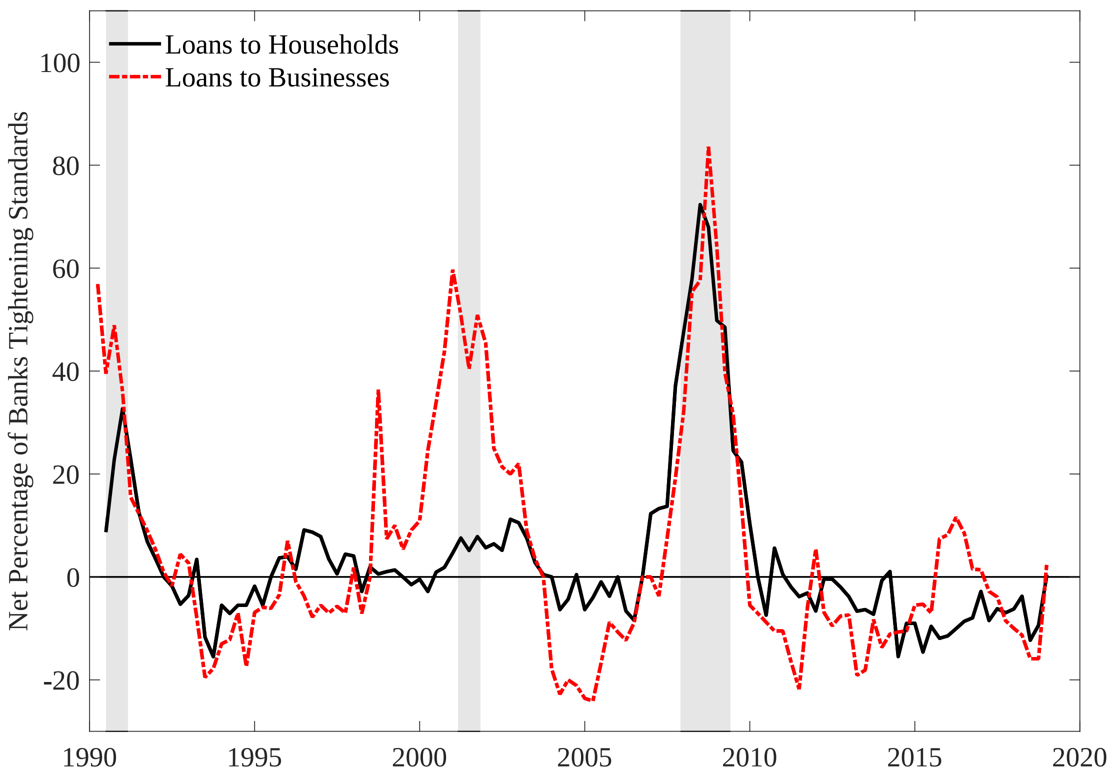


Figure 1: **Bank Tightening:** Becard and Gauthier (2022)

muted. Thus, we demonstrate that the dominance of collateral shocks derives exclusively from the post-financial crisis period of 2010 to 2019, but as mentioned above, during this period, the lending standards for households and businesses are negatively correlated. This negative movement sits oddly with the model requirement that lending standards tighten simultaneously for both households and entrepreneurs.

We conduct two counterfactual exercises to determine why collateral shocks are not dominant over the 1985:Q1-2009:Q3 period compared to the 1985:Q1-2019:Q1 period. These exercises reveal that increased estimated persistence in the collateral shock process in the latter sample is the main reason behind our findings. Based on our analysis, we conclude that the search for a single dominant financial shock that drives the U.S. business cycle and accounts for consumption dynamics in estimated DSGE models remains a significant challenge.

2 Collateral Shocks: Quantitative Results

We examine two key questions. Are collateral shocks a dominant source of U.S. business cycles? Do collateral shocks account for U.S. consumption dynamics?

We re-estimate the model developed in Becard and Gauthier (2022) for the 1985:Q1-2009:Q3, using Bayesian methods.[4] The model has 58 parameters, out of which 42 are estimated. The data used in the estimation are the standard eight time series used in the literature (for example, Justiniano, Primiceri and Tambalotti, 2010), namely, output, non-durable consumption, investment (including durable consumption), hours, inflation, federal funds rate, and the relative price of investment (RPI). In addition, Becard and Gauthier (2022) uses four financial variables: credit to households, credit to non-financial businesses, interest spread on household mortgage loans, and interest spread on business loans. The model has 13 shocks, namely, collateral, technology (three types of shocks), investment (two types of shocks), household (three types of shocks), firm (two types of shocks), and policy (two types of shocks).

Panel (a) in Table 1 presents the forecast error variance share of output to a collateral shock. Column (1) and row 'With RPI' show that the contribution of the collateral shock for the 1985:Q1-2009:Q3 period in accounting for the output variation is only 7 percent, substantially smaller than the 45 percent share estimated for the sample period 1985:Q1-2019:Q1 (Column (2)).

Early work on Bayesian estimation of DSGE models by Smets and Wouters (2007) and Justiniano, Primiceri and Tambalotti (2010) did not include RPI in the set of observables. In subsequent work, however, it has become customary to include the RPI series (see, for example, Justiniano, Primiceri and Tambalotti, 2011, Schmitt-Grohé and Uribe, 2012, Khan and Tsoukalas, 2011, Khan and Tsoukalas, 2012, among others). One of the well-known implications is that when RPI is not included in the set of observables, the

[4] Since we do not modify any aspect of their model we do not reproduce the formal model and equations here and refer the readers to Becard and Gauthier (2022).

Table 1: **Forecast Error Variance Decompositions**

	(1)	(2)
Model Estimation	1985:Q1-2009:Q3	1985:Q1-2019:Q1
With RPI	No (7%)	Yes (45%)
Without RPI	No (17%)	No (18%)

Panel (a): **Is Collateral Shock the Dominant Shock? Forecast Error Variance Share of Output**

	(1)	(2)
	1985:Q1-2009:Q3	1985:Q1-2019:Q1
Output	7%	45%
Consumption	1%	41%
Investment	12%	43%
Hours	3%	34%

Panel (b): **Collateral Shocks: Forecast Error Variance Shares**

Note: The variance decompositions are computed at the posterior mode. Business cycle frequency encompasses periodic components with cycles of 6–32 quarters.

investment-specific shock turns out to be the most dominant. In the present context, this means that we would not expect the collateral shock to dominate. The second row 'Without RPI' in Table 1 confirms this point. When RPI is not included, the collateral shock is no longer the dominant shock, even for the sample period 1985:Q1-2019:Q1. This sensitivity of variance share is noteworthy because, unlike the case of investment-specific shocks, which have a direct relationship with RPI, there is no direct relationship between RPI and the theoretical mechanism generating procyclical consumption described in the Becard and Gauthier (2022) model.

We now examine the contribution of collateral shocks in accounting for the variation in consumption over the business cycle, along with their contributions to investment and

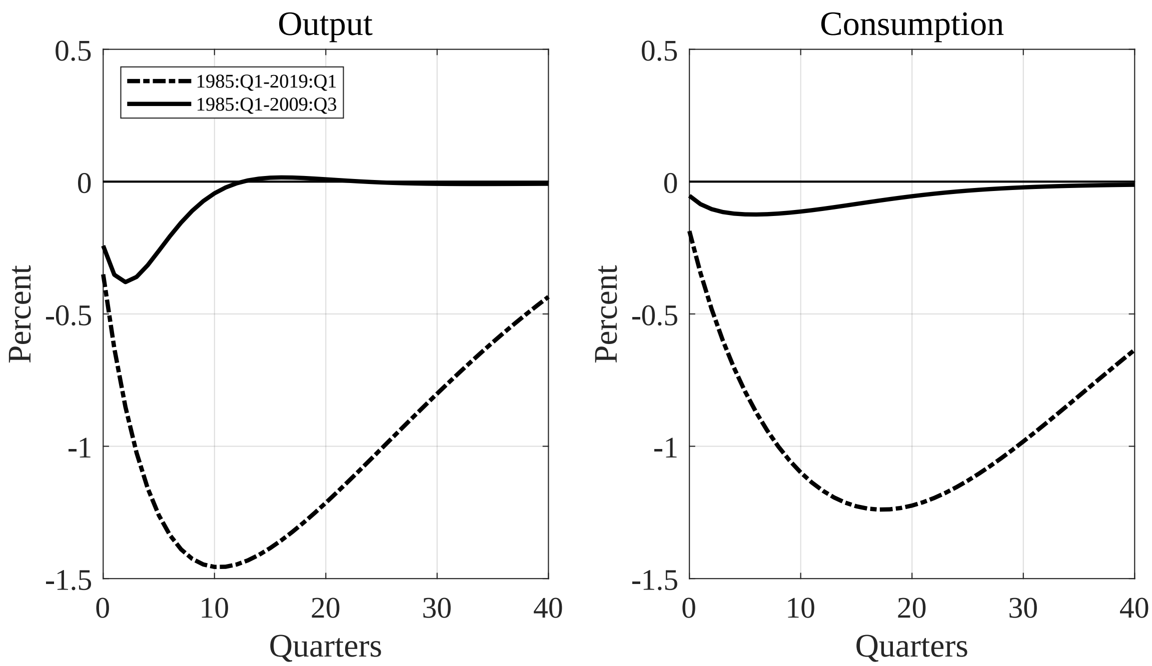


Figure 2: **Impulse Responses of Output and Consumption to a One Standard Deviation Adverse Collateral Shock**

hours.

Panel (b) - Column (1) in Table 1 reveals a striking finding: the collateral shocks hardly contribute towards accounting for the business cycle variation in consumption. The forecast error variance is one percent, a sharp decrease from the full sample finding of 41 percent (shown in Column (2)).

Figure 2 shows the impulse responses of output and consumption to a collateral shock. Relative to the 1985:Q1-2019:Q1 sample, the responses of both output and consumption in the 1985:Q1-2009:Q3 sample (shown in blue colour) are quite muted. Although the comovement property is still observed as both output and consumption decrease upon impact, it is not strong compared to the large responses for the 1985:Q1-2019:Q1 period (shown in orange colour).

3 What Breaks the Dominance of Collateral Shocks?

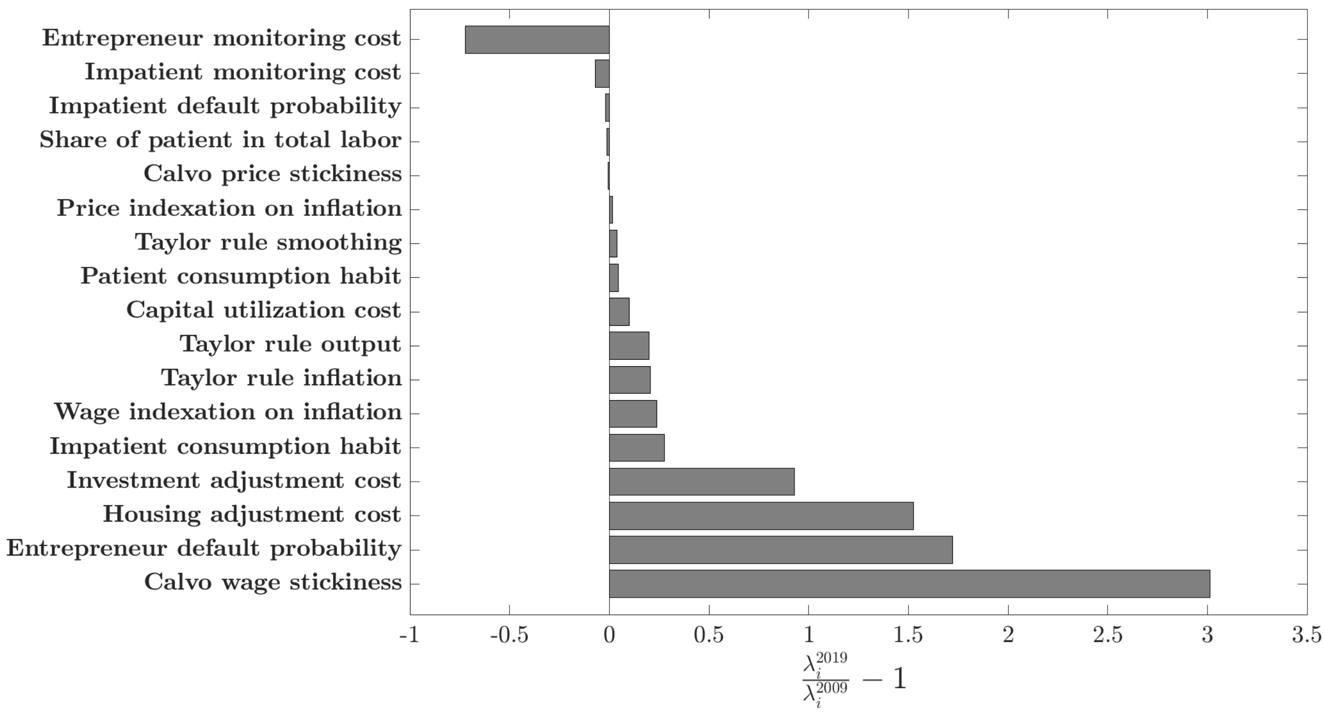
What are the key factors driving (a) the sharp drop in the variance shares displayed in Table 1 and (b) the muted comovement between consumption and output shown in Figure 2? To provide answers to these questions, we isolate the role of all the model's estimated parameters versus the estimated parameters of the collateral shock process and conduct two counterfactual exercises.

For these experiments, we first compare the magnitude of each parameter estimate based on the 1985:Q1-2019:Q1 sample, denoted as λ_i^{2019}, with the one based on the 1985:Q1-2009:Q3 sample, denoted as λ_i^{2009}.

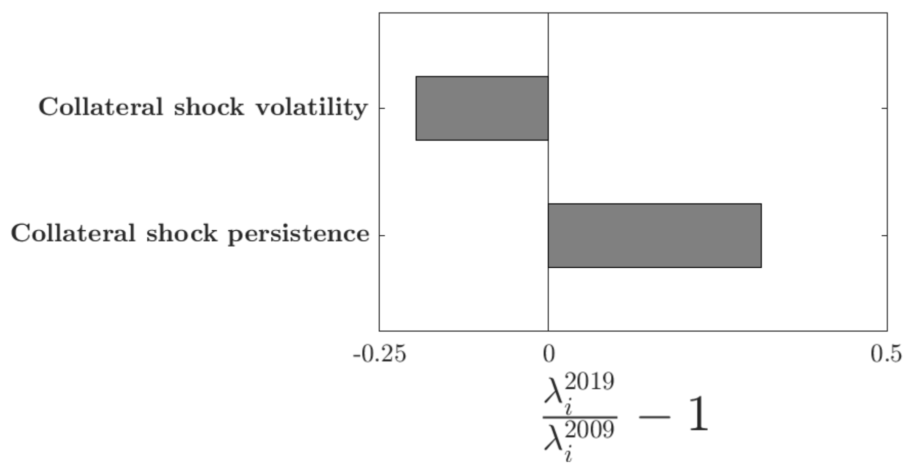
Panel (a) in Figure 3 provides this comparison for structural parameters in a succinct way. We report the ratio of the estimated values of the parameters minus one, *i.e.*, $\lambda_i^{2019}/\lambda_i^{2009} - 1$.

A value of zero means the estimated parameters are the same. A positive value means that the estimated parameter for the 1985:Q1-2019:Q1 period is that value times greater than the value for the 1985:Q1-2009:Q3 period. The estimated Calvo wage parameter, ξ_w, clearly shows the biggest change. It implies that the estimated nominal wage rigidity is three times higher for the 1985:Q1-2019:Q1 period relative to the 1985:Q1-2009:Q3 sample. The estimated default probability for entrepreneurs and the adjustment cost parameters are also relatively higher in the full sample. The estimated entrepreneur monitoring costs, however, show a decrease compared to the 1985:Q1–2009:Q3 sample.

Panel (b) in Figure 3 shows that the estimated collateral shock is more persistent but less volatile when estimated over the period 1985:Q1-2019:Q1 relative to the 1985:Q1-2009:Q3. The estimated persistence, ρ_ν, is 0.96 for the former sample and 0.73 for the latter. The estimated volatility, σ_ν, is 0.039 and 0.031 for the former and the latter samples, respectively.



Panel (a): Structural Parameters - Relative Magnitude



Panel (b): Collateral Shock Parameters - Relative Magnitude

Figure 3: **Comparing the Relative Magnitude of Estimated Parameters: 1985:Q1-2019:Q1 versus 1985:Q1-2009:Q3**

3.1 The First Counterfactual Exercise

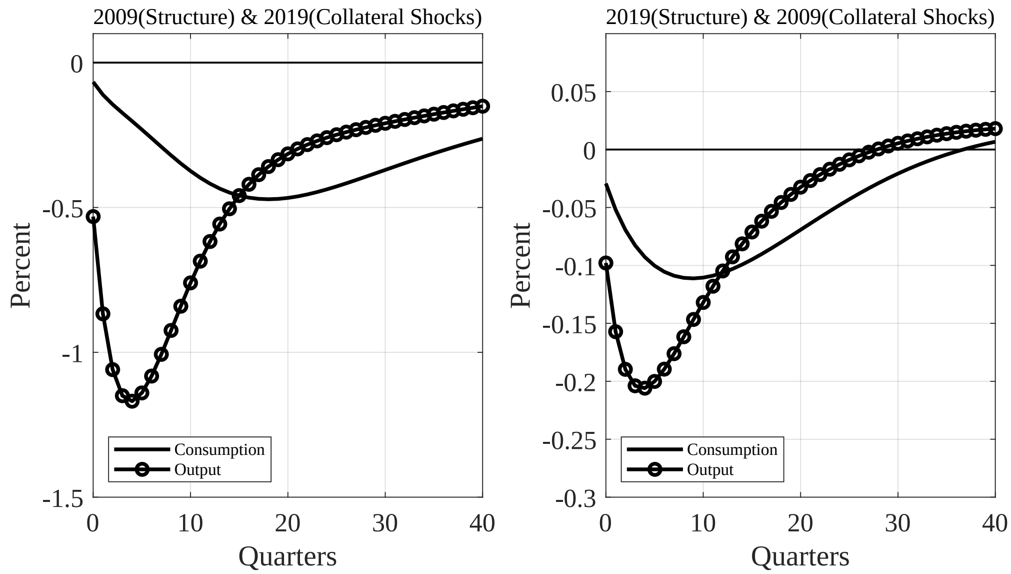
Except for the collateral shock parameters, which are estimated from the entire sample (1985:Q1-2019:Q1), we employ the estimated posterior mode of all model parameters based on 1985:Q1-2009:Q3 in our first counterfactual experiment. For convenience, we refer to this as *2009-structure* and *2019-collateral shocks*, respectively. We expect the results to be somewhere in between those shown in Figure 2 and Table 1 for the two sample periods, respectively. Specifically, this exercise isolates the influence of 2019-collateral shocks on the 2009-structure. The first figure in Panel (a) of Figure 4 shows the results. In comparison to the results produced from the estimated model for the 1985:Q1-2009:Q3 sample in Figure 2, we find that the output and consumption impulse responses are amplified and more persistent. The peak output response goes from 0.4 percent below the steady state in the third quarter to 1.2 percent in the fifth quarter after an adverse collateral shock. Similarly, the peak response of consumption is 0.5 percent below the steady state, which is more magnified than the 0.2 percent response obtained for the 1985:Q1-2009:Q3.

As it turns out, house prices rise after an adverse collateral shock, which produces a strong enough wealth effect to dampen consumption for both patient and impatient homeowners.[5] We conclude that *2009-structure* contributes towards the dampening of both output and consumption responses.

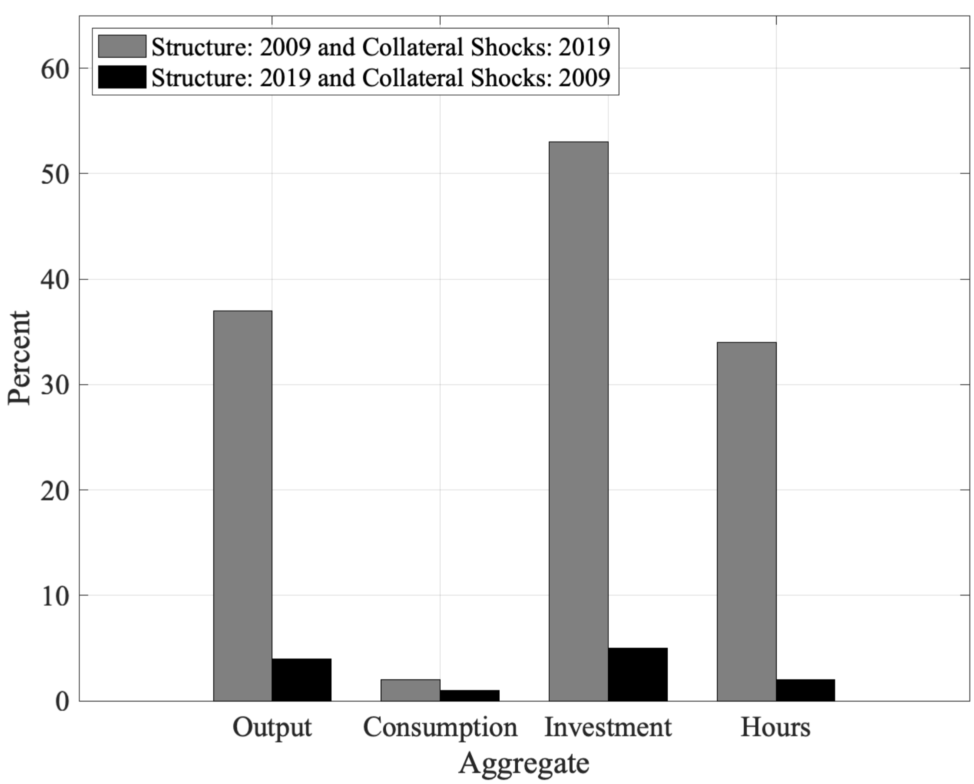
3.2 The Second Counterfactual Exercise

Except for the collateral shock parameters, which are estimated from the sample 1985:Q1-2009:Q3, we employ the estimated posterior mode of all model parameters based on 1985:Q1-2019:Q1 in our second counterfactual experiment. For convenience, we refer to this as *2019-structure* and *2009-collateral shocks*, respectively. The right figure in panel (a) of Figure 4 shows that both output and consumption responses are substantially muted, with the peak output response of 0.2 percent below the steady state and the peak consumption response of about 0.11 percent below the steady state. This exercise shows that 2009-collateral shocks do not produce the same amplification as 2019-collateral shocks. A key reason for this is that the estimated persistence of 2019-collateral shocks is nearly 32

[5]See Figure A1 in the Appendix.



Panel (a): Counterfactual Impulse Responses to a Collateral Shock



Panel (b): Variance Decomposition for Collateral Shocks: 2009 vs. 2019

Figure 4: **Counterfactual scenarios and variance decompositions.**

percent greater than that of 2009-collateral shocks, as shown in Panel (b) of Figure 4. Under the counterfactual, the decrease in wages and house prices after a negative collateral shock is substantially muted, so the negative wealth effect on consumption is not large enough to produce a strong decrease in consumption.[6]

We conclude that *2009-shocks* deliver a dampened response in the 1985:Q1-2019:Q1 sample. Put differently, including the 2009:Q4-2019:Q1 period in the model estimation is essential for obtaining the dominant role of collateral shocks. The counterfactual variance decomposition results based on the simulations reinforce this conclusion. Panel (b) of Figure 4 shows that under *2009-structure* and *2019-collateral shocks*, the collateral shocks remain dominant in accounting for the variation in output, investment, and hours. Only their contribution to the variance share of consumption decreases to 2 percent. By contrast, under the *2019-structure* and *2009-collateral shocks*, the dominance of collateral shocks is sharply lower for all four variables: output, consumption, investment, and hours.

4 Conclusion

Motivated by evidence on tightening cycles of bank lending, Becard and Gauthier (2022) have proposed collateral shocks that affect lending standards for both households and firms. Unlike the recent literature on financial shocks, this shock appears to be the dominant one in driving output and also generates consumption comovement. We, however, demonstrate that the evidence is not strong enough to conclude that collateral shocks are a dominant source of U.S. business cycles, over the 1985:Q1 to 2009:Q3 period. Collateral shocks account for only 7 percent of output variation and 1 percent of consumption variation over 1985:Q1-2009:Q3. These numbers increase to 45 percent and 41 percent when the sample includes the 2009:Q4-2019:Q1 period. But over this period, lending standards

[6] See Figure A2 in the Appendix.

for households and businesses did not comove strongly—the correlation is -0.19. This sits oddly with the underlying motivation for such shocks. The favorable evidence for the dominance of collateral shocks also requires including the relative price of investment in the set of observables for model estimation. However, there is no direct link between bank lending standards and the relative price of investment in the estimated model, and the latter is included in the observables based on other reasons noted in the previous literature. The search for a quantitatively important financial shock that drives the U.S. business cycle and also accounts for consumption dynamics, therefore, remains a major challenge.

References

Ajello, Andrea. 2016. "Financial Intermediation, Investment Dynamics, and Business Cycle Fluctuations." *American Economic Review*, 106(8): 2256–2303.

Becard, Yvan, and David Gauthier. 2022. "Collateral Shocks." *American Economic Journal: Macroeconomics*, 14(1): 83–103.

Bernanke, Ben, and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review*, 79(1): 14–31.

Bernanke, Ben S, Mark Gertler, and Simon Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." *Handbook of Macroeconomics*, 1: 1341–1393.

Carlstrom, Charles T, and Timothy S Fuerst. 1997. "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis." *The American Economic Review*, 893–910.

Christiano, Lawrence J., Roberto Motto, and Massimo Rostagno. 2014. "Risk Shocks." *American Economic Review*, 104(1): 27–65.

Drechsel, Thomas. 2023. "Earnings-Based Borrowing Constraints and Macroeconomic Fluctuations." *American Economic Journal: Macroeconomics*, 15(2): 1–34.

Gerali, Andrea, Stefano Neri, Luca Sessa, and Federico M. Signoretti. 2010. "Credit and Banking in a DSGE Model of the Euro Area." *Journal of Money, Credit and Banking*, 42: 107–141.

Iacoviello, Matteo. 2015. "Financial Business Cycles." *Review of Economic Dynamics*, 18(1): 140–163.

Jermann, Urban, and Vincenzo Quadrini. 2012. "Macroeconomic Effects of Financial Shocks." *American Economic Review*, 102(1): 238–71.

Justiniano, Alejandro, Georgio Primiceri, and Andrea Tambalotti. 2011. "Investment Shocks and the Relative Price of Investment." *Review of Economic Dynamics*, 14: 101–121.

Justiniano, Alejandro, Giorgio E Primiceri, and Andrea Tambalotti. 2010. "Investment shocks and business cycles." *Journal of Monetary Economics*, 57(2): 132–145.

Khan, Hashmat, and John Tsoukalas. 2011. "Investment Shocks and the Comovement Problem." *Journal of Economic Dynamics and Control*, 35: 115–130.

Khan, Hashmat, and John Tsoukalas. 2012. "The Quantitative Importance of News Shocks in Estimated DSGE Models." *Journal of Money, Credit and Banking*, 44(8): 1535–1561.

Kharazi, Aicha. 2022. "Macroeconomic Effects of Collateral Requirements and Financial Shocks." Manuscript.

Kiyotaki, Nobuhiro, and John Moore. 1997. "Credit Cycles." *Journal of Political Economy*, 105(2): 211–248.

Liu, Zheng, Pengfei Wang, and Tao Zha. 2013. "Land-Price Dynamics and Macroeconomic Fluctuations." *Econometrica*, 81(3): 1147–1184.

Negro, Marco Del, Gauti Eggertsson, Andrea Ferrero, and Nobuhiro Kiyotaki. 2017. "The Great Escape? A Quantitative Evaluation of the Fed's Liquidity Facilities." *American Economic Review*, 107(3): 824–57.

Quadrini, Vincenzo. 2011. "Financial Frictions in Macroeconomic Fluctuations." *Economic Quarterly*, 97(3): 209–254.

Schmitt-Grohé, Stephanie, and Martín Uribe. 2012. "What's News in Business Cycles." *Econometrica*, 80(6): 2733–2764.

Smets, Frank, and Rafael Wouters. 2007. “Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach.” *American Economic Review*, 97(3): 586–606.

A Appendix: Counterfactual Impulse Responses

Figure A1: **Impulse Response to Collateral Shocks: Becard and Gauthier (2022) vs. Counterfactual of *2009-Structure* and *2019-Collateral Shocks***

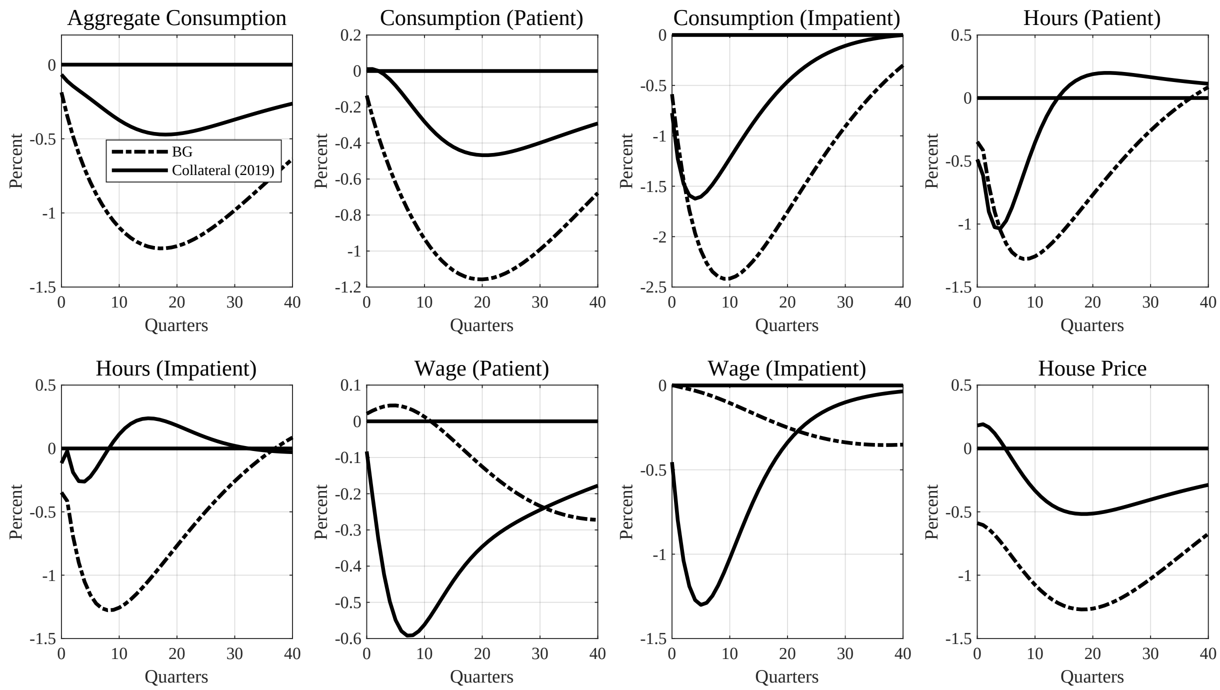


Figure A2: **Impulse Response to Collateral Shocks: Becard and Gauthier (2022) vs. Counterfactual of *2019-Structure* and *2009-Collateral Shocks***