The Effects of the Secondary Market for Corporate Loans on the Real Economy*

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Abstract

An increasing share of corporate loans, a critical source of firm credit, are sold off of banks' balance sheets and actively traded in a secondary over-the-counter market. We develop a microfounded equilibrium search-theoretic model with labor, credit, and financial markets to study the impact of this secondary loan market on the real economy. Our analysis highlights a policy-relevant trade-off: the market reduces the steady-state level of unemployment by 0.21pp, but it also amplifies unemployment's response to a 1% productivity drop by 0.07pp. Trading delays in the secondary market matter significantly: if trade were instantaneous, steady-state unemployment and its volatility would decline by 1.49pp and by 0.24pp, respectively.

JEL Classification: E24, E44, E51, G11, G12, G21, J64

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1 Introduction

Loans from commercial banks constitute one of the most common avenues for firms to finance their borrowing needs.[1] Over the last two decades, an active secondary market for these corporate loans has developed both in the United States and in Europe, where loans are traded over-the-counter like debt securities. This financial innovation may have important macroeconomic implications for at least two reasons. First, there is strong micro-level evidence linking the secondary loan market to firm-level outcomes such as the ease and cost of obtaining credit, employment growth, and industrial production (Chodorow-Reich, 2014; Saunders et al., 2025). Second, corporate loans play a large role in recent policy conversations about corporate indebtedness, since their value has doubled in size over the last 15 years (Kaplan, 2019; IMF, 2018).[2] Despite their theoretical and policy importance, the linkages of the secondary corporate loan market with the real economy have not been studied in the macroeconomic literature.

We fill this gap by developing a microfounded general equilibrium framework that encompasses the following three markets: a credit market, in which banks give loans to new and existing firms to finance their borrowing needs; a labor market, in which new firms match with workers to produce output; and a secondary financial market, in which dealers securitize and sell to investors the loans acquired from commercial banks. We first study a parsimonious partial equilibrium model where the price of securitized loans in the secondary market is fixed. This allows us to highlight analytically that the introduction of a secondary loan market comes with a trade-off. On the one hand, it increases the profitability of the credit contract between banks and entrepreneurs, which leads to a lower level of unemployment. On the other hand, secondary loan trading makes credit contracts more sensitive to macroeconomic conditions, thereby increasing the sensitivity of unemployment to real disruptions. We then develop a richer general equilibrium model with endogenous secondary loan prices and firm capital expenditure, which we take to the U.S. data. Our quantitative

[1] In the fourth quarter of 2022, outstanding loan liabilities for non-financial corporate business in the U.S. were $5.4 trillion, amounting to more than two thirds of corporate debt securities outstanding and a fifth of GDP. In fact, Sufi (2007) reports that as early as 2005 the primary market issuance in the corporate loan market exceeded that of the primary corporate bonds market. Additionally, Saunders et al. (2025) report that the market for syndicated loans is one of the most important sources of financing for firms. Of the publicly traded nonfinancial firms in Compustat, Saunders et al. (2025) report that 70% were syndicated loan issuers for the period 1999 to 2020. Moreover, half of the firms in their sample were private enterprises and thus had to rely on financing through bank loans.

[2] The Federal Reserve even included the secondary market for corporate loans in the announcement of the Primary Market Corporate Credit Facility as a target market for its interventions on the eve of the Covid recession; see Boyarchenko et al. (2022) for details.

analysis reveals that the introduction of a secondary loan market reduces the steady-state unemployment rate by 0.21 percentage points (pp). At the same time, our benchmark economy features higher unemployment volatility: a 1% drop in productivity raises steady-state unemployment by 0.46pp versus 0.39pp in an economy without a secondary market. Importantly, we find that trading delays in the secondary loan market have large consequences for the real economy. If trade were instantaneous, our numerical results predict a steady-state unemployment level of 4.51% (versus 6% in the benchmark) and an increase in unemployment of only 0.22pp following a 1% productivity decline. These results underscore that the impact of the secondary corporate loan market on real activity is highly dependent on the efficiency with which that market operates.

The modeling of each market follows an established path from the search and matching literature: the credit market builds upon Wasmer and Weil (2004), the labor market upon Diamond (1982) and Mortensen and Pissarides (1994), and the secondary market follows Duffie, Gârleanu, and Pedersen (2005). We henceforth refer to these models as WW, DMP, and OTC, respectively. The real side of the economy is populated by entrepreneurs, workers, and banks. Entrepreneurs have access to a production technology, but need workers in order to produce. Entrepreneurs and workers meet on the labor market, which is subject to frictions: finding a suitable counterparty takes time and resources. Moreover, entrepreneurs are liquidity constrained: they do not have the funds to finance the search for workers; instead, they first need to obtain financing from a bank. The entrepreneur and the bank participate in a credit market also subject to search frictions: it takes time and resources to find a suitable counterparty with which to form a credit partnership. Once the entrepreneur secures funding from a bank, the bank finances the labor market search costs until the entrepreneur finds a worker. At that point, production begins and the entrepreneur starts repaying the loan. Banks have the option to securitize and sell loans in a secondary market. This secondary loan market has the OTC structure from Duffie et al. (2005): investors have heterogeneous valuations for an asset which periodically change due to preference shocks, generating trade incentives.[3] The asset traded in the OTC market consists in a securitized stream of repayments from the loans banks issue to entrepreneurs in the primary credit market. At an exogenous contact rate, investors/customers meet with dealers, who execute buy and sell orders on their behalf in a perfectly competitive inter-dealer market.

An important departure from all three aforementioned frameworks is the introduction of

[3]The OTC literature has provided multiple foundations for this preference structure. It captures investors with heterogeneous and time-variant beliefs about the asset quality, hedging needs, or consumption opportunities.

a motive for banks to securitize loans. In particular, banks incur costs associated with the amount of the loan retained on their balance sheet. This modeling innovation finds strong empirical support in the finance literature: banks that offload part of their loans economize on the monitoring, servicing, and balance sheet costs associated with these loans (see the detailed references in Section 1.1). Moreover, some authors (see, for example, Simons 1993) even argue that sharing on the costs of the loan is precisely the reason why banks securitize loans in the first place. For ease of exposition we refer to these costs as *loan-servicing costs*, but interpret them broadly to also include monitoring as well as balance sheet costs.

Importantly, loan-servicing costs allow us to model banks facing a non-trivial decision of what fraction of the loans to keep on their balance sheet. Not only does this make our model consistent with key aspects of the data, but also generates several novel insights. Most notably, we show analytically that loan-servicing costs act as an automatic stabilizer: following a decrease in productivity, the economy with loan-servicing costs experiences fluctuations of a lower magnitude than an economy where banks do not incur these costs. This is the case because loan-servicing costs affect the size of the fundamental surplus, the model object which determines the magnitude of the response of labor market tightness to productivity changes (Ljungqvist and Sargent, 2017). Intuitively, a productivity drop reduces the match surplus between a banker and an entrepreneur, which, in turn, lowers vacancy creation. As a result, there is less congestion in the labor market, vacancies are filled faster, and banks issue less credit to cover the entrepreneurs' search cost. In an economy with loan-servicing costs this means lower operating expenses for banks, which raises their profits and partially counteracts the negative effect of the drop in productivity.[4]

Turning to the impact of the secondary loan market, we find it moves in the opposite direction: it amplifies the magnitude of productivity shocks on the economy when asset prices are fixed.[5] Intuitively, when there is a secondary loan market, banks solve a portfolio choice problem and securitize some of the loans on their books. This ties the equilibrium level of loan-servicing costs to the price of the asset on the secondary market. Under fixed asset prices loan-servicing costs are constant, which eliminates their stabilizing effect. Hence, the

[4]Intuitively, this works similarly to a progressive tax system in the baseline real business cycle model. Generally, a negative output shock lowers wages, which decreases labor supply. With progressive taxation, however, lower wages reduce income, hence the household's marginal tax rate decreases. This creates a counter effect which pushes the labor supply up. As a result, business cycle fluctuations are dampened.

[5]Specifically, our analytical results are derived under partial equilibrium, where we fix the price of loans in the secondary market. This allows us to study the direct effect of having access to a secondary market in a tractable way. We consider the full general equilibrium effects with endogenous asset prices in our quantitative exercises.

existence of a frictional secondary loan market mitigates the ability of loan-servicing costs to serve as an automatic stabilizer.

To perform quantitative analysis, we enrich our model to include credit for incumbent firms, endogenous secondary loan prices, as well as the need for capital in production. The calibrated model matches a rich set of identified and unidentified moments (Nakamura and Steinsson, 2018), making it an excellent laboratory for our numerical experiments. Our first goal is to understand the impact of loan-servicing costs and secondary loan trading on the real economy. To this end, we calculate the steady-state unemployment level in alternative models and compare it to the steady-state level in the benchmark economy. We find that in the absence of the secondary loan market, unemployment would be 0.21pp higher. Intuitively, when banks can sell off loans, they optimally choose to securitize a fraction of them to save on loan-servicing costs. As a result, banks experience lower operating costs, which incentivizes larger credit provision and ultimately higher vacancy creation. Looking further into the importance of the secondary market for the real economy, we ask "how high would unemployment have been if there were no frictions in the loan market?" Our calibration suggests that eliminating frictions in the OTC market would result in a 1.41pp lower unemployment than in the benchmark economy. Intuitively, reducing frictions in the secondary market leads to faster reallocation of the asset to high-value investors, which increases its price. This higher price, in turn, makes lending more profitable, which stimulates credit provision and vacancy creation. We also estimate that eliminating loan-servicing costs reduces steady-state unemployment by 2.06pp. Thus, the OTC secondary loan market offsets more than a tenth of the drag that loan-servicing costs impose on employment; a frictionless market would almost eliminate it.

Our second goal is to study the propagation of shocks, which we investigate in a series of steady-state comparative statics exercises. We find that, following either a decrease in productivity or an increase in the costs banks incur to participate in the credit market, the benchmark model exhibits larger responses than an alternative economy without a secondary loan market. Both of these economies are, in turn, more responsive than an economy with a frictionless secondary loan market. For example, a 1% reduction in productivity leads to an unemployment increase of 0.46pp in the benchmark model; 0.39pp in the economy without a secondary market; and 0.22pp in the economy with a frictionless secondary market. Intuitively, in our benchmark economy prices do not respond much to changes in supply due to the frictions on the secondary market. Consequently, an economy with a secondary loan market exhibits larger volatility than an economy without. When the secondary market is frictionless, however, the asset price strongly responds to changes in asset supply. This makes loan-servicing costs even more volatile than in the economy without a secondary market, which boosts their ability to dampen fluctuations.

Our paper bears interesting lessons for researchers and policymakers alike. Firstly, we provide a theoretical framework to study the mechanisms through which the secondary loan market affects production and unemployment. Specifically, our model can rationalize the negative relationship between secondary market spreads and real macroeconomic variables established by Saunders et al. (2025). Secondly, our quantitative findings lend credence to the worries of policymakers regarding the macroeconomic risks of turmoil in secondary financial markets. In particular, when we lower investors' valuations to engineer an asset price drop similar in magnitude to the one observed in the 2008 financial crisis, the model predicts a 0.21pp increase in the unemployment rate. Thus, our model implies that a drop in the price of securitized loans *alone* can explain a non-trivial fraction of the unemployment increase observed during the Great Recession. Importantly, the model with a frictionless secondary market delivers an even larger unemployment increase of about 1.34pp, following the same asset price drop. This highlights a challenging policy trade-off: eliminating frictions in the secondary market improves the steady-state level of macroeconomic aggregates and lowers the sensitivity of the economy to real shocks, but raises its sensitivity to financial shocks.

The rest of the paper is organized as follows. We continue this section with a review of the related literature, before detailing the institutional background of the secondary loan market and the importance of loan-servicing costs for loan securitization in Section 1.1. Section 2 develops the simplified model and highlights our main analytical results: loan-servicing costs act as an automatic stabilizer, but a secondary loan market with a stable price serves to mitigate their impact on the magnitude of business cycle fluctuations. Section 3 presents the richer model with incumbent firm financing, capital expenditures and endogenous asset prices, while Section 4 presents the model's calibration strategy. In Section 5, we provide the quantitative results and Section 6 concludes.

Related Literature. Our paper contributes to several strands of the macroeconomic literature. First, we focus on imperfections in the credit and labor markets. As such, our model is closely related to a vast search-theoretic literature on the labor market. Some of the early seminal papers include Diamond (1982) and Mortensen and Pissarides (1994). Our work is more narrowly related to papers which investigate credit frictions within the DMP class of models. Specifically, following the seminal work of Wasmer and Weil (2004) a large body of work has studied the macroeconomic impact of credit and labor market frictions.[6] For example, Petrosky-Nadeau and Wasmer (2013) provide a dynamic extension of the baseline model, while Petrosky-Nadeau (2013) introduces firm heterogeneity to study the cyclical behavior of TFP. We contribute to that strand of literature by introducing a secondary loan market, a loan-servicing cost for banks, and credit needs for incumbent firms.

A central feature of our paper is the secondary loan market which we model as an OTC market with search frictions. Our paper is thus related to a large search-theoretic literature following the seminal work in Duffie et al. (2005, 2007); see Hugonnier et al. (2025) for a comprehensive survey.[7] Our contribution to that literature is to study the linkages of a specific OTC financial market with the real economy. Other authors making this connection focus on different markets and study different linkages; see He and Milbradt (2014), Bethune, Sultanum, and Trachter (2019), Cui and Radde (2020), and Kozlowski (2021).

Another important ingredient of our theoretical framework is the cost of operating a loan that banks incur, and the related decision of what fraction of the loan a bank should keep on its books. Our paper is thus related to studies which have examined the importance of the ability of banks to sell their loans for measuring shock amplification through financial intermediaries (Buchak et al. 2023, 2024; Irani and Meisenzahl 2017). We motivate the loan-servicing costs through the observation that there are both balance sheet and monitoring costs associated with servicing a loan.[8] As such, our paper is related to an extensive literature

[6] For a comprehensive list, see Chapters 5 and 6 in Petrosky-Nadeau and Wasmer (2017) and the papers cited therein. A body of literature has used the alternative modeling approach found in New Monetarist papers to study the connection between credit frictions and unemployment. See, for example, Bethune et al. (2015), Branch and Silva (2021), Bethune and Rocheteau (2023), and Gabrovski et al. (2025b). Moreover, other approaches merge a DMP labor market with alternative mechanisms to connect financial markets with unemployment. See, among others, Monacelli et al. (2011), Rocheteau and Rodriguez-Lopez (2014), Buera et al. (2015), Eckstein et al. (2019), Shapiro and Olivero (2020), Dong (2022), and Kehoe et al. (2022).

[7] In particular, our OTC market closely follows the benchmark model surveyed in Weill (2020). The only point of departure is that assets mature at some exogenous rate, and that the asset supply in our economy is endogenous. Most closely related to ours are models where investors have discrete asset holdings, their types are uncountably many, there is a perfectly competitive inter-dealer market, and search is random. The literature has also studied models which have only some of these properties as well (Lagos and Rocheteau, 2009; Üslü, 2019; Gabrovski and Kospentaris, 2021; Hugonnier et al., 2022).

[8] There are a number of costs associated with keeping a loan on one's balance sheet. The empirical literature has provided evidence that capital requirements can have a negative effect on bank lending in the context of different regulatory regimes. See Haubrich et al. (1993); Berger and Udell (1994); Peek and Rosengren (1997); Bridges et al. (2014); Fratzscher et al. (2016); Bordo and Duca (2018); Koont and Walz (2021); Malovaná and Ehrenbergerová (2022) among others. Moreover, there is empirical evidence that the loan syndication market exists because of regulatory restrictions on banks such as capital requirements and lending limits (Simons, 1993), and that banks which are more capital-constrained retain smaller portions of the loan (Simons, 1993; Jones et al., 2005). The importance of monitoring and control rights of creditors has also been extensively documented: Chava and Roberts (2008); Roberts and Sufi (2009); Nini et al. (2012);

on the importance of balance sheet costs which take the form of collateral constraints, funding liquidity, margin requirements, regulatory capital requirements, and leverage constraints among others. Specifically, we contribute to the line of studies examining the impact of balance sheet costs on asset prices and asset supply (Kiyotaki and Moore, 1997; Chowdhry and Nanda, 1998; Brunnermeier and Pedersen, 2009). Also related is the literature on monitoring costs and their macroeconomic implications — see Chen (2001), Meh and Moran (2010), and Williamson (2012) among others. Unlike all of these papers, we study the aggregate implications of loan-servicing costs in the context of an economy which features frictional credit and secondary loan markets.

Our paper studies the macroeconomic implications of frictions in a financial OTC market.[9] As such, it is related to a growing literature which investigates the impact of financial frictions within New Monetarist economies. See, for example, Geromichalos, Herrenbrueck, and Lee (2018) and Gabrovski et al. (2025a). In contrast to these papers, we focus on the secondary loan market and there is no room for money in our analysis. Lastly, our work is to a lesser extent connected to a voluminous literature which studies the impact of financial frictions on the real economy in models with nominal and credit frictions: see Bernanke et al. (1999), Gertler and Kiyotaki (2010), and Jermann and Quadrini (2012), among others.

1.1 Institutional Background

The secondary loan market. A secondary market for corporate loans emerged in the United States in the 1990s (Marsh and Virmani, 2022). The founding of the Loan Syndication and Trading Association (LSTA) in 1995, which standardized loan contracts and procedures, had a large positive impact on secondary market activity. Since then, the secondary market has been an active dealer-driven market, in which loans are traded similarly to debt securities (Saunders et al., 2025). Typically, corporate loans traded in the secondary market are syndicated. A syndicated loan is a loan provided by a group of lenders who pool funds together ("syndicate") to provide them to a single borrower.[10] The syndicated loans market

Matvos (2013); Becker and Ivashina (2016); Green (2018); Berlin et al. (2020) among others.

[9]To a lesser degree, our paper is related to the search-theoretic literature on the housing market, which operates over-the-counter, and where assets are discrete. See, for example, Wheaton (1990), Head, Lloyd-Ellis, and Sun (2014), Gabrovski and Ortego-Marti (2019, 2021, 2025), Albrecht, Gautier, and Vroman (2016), Gabrovski et al. (2024), and Garriga and Hedlund (2020).

[10]Typically, the syndication process is led by a "lead arranger," a commercial or investment bank that arranges the loan details with the borrower and recruits other participant intermediaries (which include banks and institutional investors). Although both the lead arrangers and the other participants sign the loan contract with the borrower, the lead arranger retains a larger share of the loan than the participants

is one of the most important sources of private debt for corporations (Kaplan, 2019). For example, Chodorow-Reich (2014) reports that syndicated loans account for almost half of total commercial and industrial lending in the U.S., and two-thirds of lending with a maturity longer than a year, while Saunders et al. (2025) report that about 70% of nonfinancial Compustat firms were syndicated loan issuers from 1999 to 2020. The market serves both publicly traded and private firms: in both Chodorow-Reich (2014) and Saunders et al. (2025) datasets, half of the borrowing firms are private. The vast majority of loans traded in the secondary market are "leveraged loans" (made to borrowers with high levels of debt), whose value recently peaked at almost 1.4 trillion (Marsh and Virmani, 2022) (see also Lee et al. 2019 and Bochner et al. 2020). The market's turnover rate is about 70% (Siedlarek and Yankov 2025; see also recent reports by the Loan Syndications and Trading Association) — considerably larger than the 40% in the municipal bond market (Hugonnier et al., 2020).

The importance of loan-servicing costs for loan securitization. One might wonder what incentives do banks have to syndicate loans and/or trade them on a secondary market. The literature has identified several reasons for it, some obvious and some subtle. When several banks hold parts of a single loan, each of them has a smaller exposure to the loan, which serves to share the risk between banks (Wilson, 1968; Chowdhry and Nanda, 1996). Another reason for the existence of syndication might be because such a loan arrangement is the most efficient one to deal with moral hazard and adverse selection issues (Pichler and Wilhelm, 2001). Indeed, when several banks co-manage a loan, they can monitor the lead arranger to ensure that it does not systematically syndicate the most risky loans and that it does not shirk on its monitoring functions. A related hypothesis is that banks syndicate loans because that helps them specialize and therefore save on loan-servicing costs. In particular, Das and Nanda (1999) show that syndication is an efficient way for banks to specialize optimally. Lastly, the literature has speculated that banks engage in syndication because of capital and regulatory requirements, as pointed out by Simons (1993).

Empirically, there is much support for the latter two hypotheses, according to which banks securitize loans to save on loan-servicing costs such as balance sheets and monitoring costs. For example, Simons (1993), Jones et al. (2005), and Irani et al. (2021) show that more capital constrained banks retain smaller portions of the loan; Buchak et al. (2024) find that banks shift their lending activities towards loans they can sell when their capitalization declines; François and Missonier-Piera (2007) find evidence that banks share the cost of managing

(Chodorow-Reich, 2014). See FSB (2019), Lee et al. (2019), Kundu (2020), and Marsh and Virmani (2022), along with the other references in this section, for detailed market descriptions.

the syndicate.[11] Following the seminal works of Diamond (1984) and Fama (1985), there are ample examples in the literature that emphasize the role of banks as monitors. Most closely related to our research question are papers which have examined the monitoring role of banks in the context of loan syndication. For instance, Berlin et al. (2020) find that borrowers in the leveraged loan market are still subject to financial covenants and monitoring; Plosser and Santos (2016) find that both the lead originator and syndicate participants engage in monitoring and that more economically significant loans are associated with more monitoring; Sufi (2007) finds that the lead bank retains a higher share of the loan and forms more concentrated syndicate when the borrower requires more intense monitoring and due diligence; Wang and Xia (2014) find that banks exert less ex-post monitoring effort on securitized loans; Gustafson et al. (2021) find a positive correlation between the portion retained by the lead arranger and monitoring activity, as well as that about half of syndicated loan borrowers provide information to the lender at least on a monthly basis and about a fifth of loans involve active monitoring (a costly action taken by the bank or third-party appraisers that includes regular borrower site visits.)

Taken as a whole, the empirical evidence suggests that the bank's function as a monitor is important whether or not the loan is syndicated. All syndicate participants share in on the monitoring, servicing, and balance sheet costs of the loan (Plosser and Santos, 2016); however, the larger the portion of the loan retained by a bank the more effort on monitoring it exerts. Moreover, as some authors have pointed out, sharing in on the costs of the loan is the reason why banks syndicate loans in the first place (Simons, 1993). Thus, in order to capture a realistic motive for banks to participate in the secondary loan market in our theoretical framework we introduce loan-servicing costs for banks which are strictly increasing in the portion of the loan the bank retains on its balance sheet.

The importance of syndicated loans for firm outcomes. In practice, firms use bank loans to finance a myriad of activities, including investment, working capital, and managing corporate liquidity (Ivashina and Scharfstein, 2010; Chen and Kieschnick, 2018; Sufi, 2009;

[11] These findings are in accordance with the extensive empirical support that balance sheet costs impose a significant burden for banks in practice. For example, Koont and Walz (2021) show that relaxing the Supplementary Leverage Ratio in 2020 led to a shift in banks' loan supply schedule; Bordo and Duca (2018) show that the Dodd-Frank Act has negatively impacted small business lending; Kovner and Van Tassel (2022) empirically establish a link between the regulatory requirements in the Dodd-Frank Act, the cost of capital for banks, and ultimately the supply and pricing of loans; Berger and Udell (1994) find that more stringent leverage requirements and tighter loan portfolio examination criteria negatively impacted the supply of commercial loans; Bridges et al. (2014) find than an increase in capital requirements leads to a decrease in supply of commercial loans in the UK.

Kashyap et al., 2002; Gatev and Strahan, 2006; Lins et al., 2010; Yun, 2009). Syndicated loans are no exception to the rule. Using a sample of 12,672 syndicated loans, Sufi (2007) reports that approximately 42% of loans finance working capital/satisfying corporate needs, while 27% and 14% respectively support refinancing activities and mergers and acquisitions. Similarly, Gupta et al. (2008) show that roughly 15% of securitized loans in their sample finance short-term projects, with the remainder allocated to long-term financing, restructuring, and capital budgeting. More recent evidence is also consistent with this view: Nadauld and Weisbach (2012) documents that firms frequently use loan proceeds for working capital, corporate expansion, and acquisition financing. This wide range of uses is also found in our model, where syndicated credit finances both capital and labor decisions, consistent with the broad set of activities documented in the data.

The empirical literature has also documented the importance of syndicated lending to firms by studying the propagation of shocks in the secondary loan market to firm-level outcomes. Chodorow-Reich (2014) provides a seminal contribution by exploiting variation in syndicated loan supply during the 2008–2009 financial crisis. The identification strategy leverages firms' exposure to Lehman Brothers' cosyndication network: because syndication relationships are persistent, the collapse of Lehman Brothers sharply reduced the lending capacity of its partner banks. This contraction translated into higher interest rate spreads and a lower likelihood of obtaining credit for firms with prior exposure to Lehman-affiliated lenders. Crucially, affected firms experienced a substantial decline in employment growth. The causal evidence in Chodorow-Reich (2014) therefore aligns closely with the mechanism in our model: disruptions in the syndicated loan market propagate to real firm outcomes, particularly employment. Broader evidence is also consistent with this conclusion. Saunders et al. (2025), for example, show that measures of secondary-loan-market spreads statistically predict employment, unemployment, and industrial output, while a large body of work documents sizable employment effects of credit shocks more generally (e.g., Bentolila et al. (2017); Berton et al. (2018); Huber (2018); Cingano et al. (2016); Greenstone et al. (2020); Siemer (2019); Gertler and Gilchrist (2018)). Taken together, these findings indicate that syndicated lending is not only a financial intermediation activity, but also an important determinant of real economic activity.

2 Simplified Model and Theoretical Mechanisms

We begin by laying out a simple model which we employ to study the main theoretical channels connecting financial and real variables analytically. The model is essentially the economy of Wasmer and Weil (2004) (WW henceforth) with two extensions: i) banks face loan-servicing costs when they provide loans to entrepreneurs and ii) banks have the option to securitize and sell part of the loan in a secondary market at an exogenous price. We also derive the steady-state elasticity of labor market tightness with respect to productivity shocks and show how it is affected by the inclusion of loan-servicing costs and the option to sell part of the loan in the secondary market. This derivation extends the approach of Ljungqvist and Sargent (2017) to our economy and places our model in the context of the labor search-and-matching literature. The model of this section is a stripped-down version of the richer general equilibrium model which we introduce in Section 3 and then calibrate and use for quantitative analysis in Sections 4 and 5.

2.1 Environment

Time, agents, and preferences. Time is continuous and runs forever. The economy is populated by continua of three types of agents: workers, entrepreneurs, and bankers. The mass of workers is exogenously fixed, while the masses of entrepreneurs and bankers are determined endogenously through free entry. All agents discount the future at rate r and enjoy linear utility over the numeraire good, with marginal utility normalized to one.

Job creation and production. Each entrepreneur has access to a productive project, i.e., a technology that produces a flow output $y > 0$. The technology requires one worker in order to be used. Workers can be hired in a frictional labor market à la DMP, where entrepreneurs must spend time and resources to open a vacancy and search for a suitable job candidate. Specifically, an entrepreneur attempting to find a worker faces a pecuniary flow search cost χ. Following Pissarides (2000), we assume that matching is random and occurs through a matching function $M^L(\mathcal{U}, \mathcal{V})$, where $\mathcal{U}$ is the number of unemployed workers and $\mathcal{V}$ is the number of vacancies. We further follow the literature and assume that the matching technology exhibits constant returns to scale and is strictly increasing in both arguments (see, e.g., Petrongolo and Pissarides 2001). The matching rate for entrepreneurs is $q(\theta) \equiv M^L(\mathcal{U}, \mathcal{V})/\mathcal{V} = M^L(\mathcal{U}/\mathcal{V}, 1)$, where $\theta \equiv \mathcal{V}/\mathcal{U}$ represents the labor market tightness. Symmetrically, this implies that the job-finding rate for a worker is $\theta q(\theta)$. The wage paid by an entrepreneur to a worker, w, is fixed exogenously.[12] Operating projects are terminated at Poisson rate s, in which case the entrepreneur and the worker separate.

Financing. As in WW, entrepreneurs are liquidity constrained and cannot self-finance the costly job-filling search activities. Each banker has deep pockets and the ability to issue exactly one loan to an entrepreneur. In the model, we interpret bank loans broadly, encompassing both term loans and credit lines. Similarly, we interpret the hiring costs which the loans fund broadly: they include the payroll costs of managers conducting interviews, the vacancy ad posting fees, as well as the cost of capital expenditures associated with creating a vacancy. In Section 3, we explicitly differentiate between the capital expenditures and the pure vacancy costs in order to more accurately capture salient features of the data, but for now we lump them together to highlight our main model mechanisms in a clear way. The credit market is subject to search and matching frictions similar to the frictions present in the labor market: it takes time and effort for entrepreneurs to secure financing and for banks to find and screen suitable projects to finance. Entrepreneurs searching for financing incur a non-pecuniary flow search cost c. Bankers searching for a worthwhile project to finance incur flow costs κ, which can be interpreted as the cost of screening applicants and keeping liquidity idle.[13] Matching between bankers and entrepreneurs occurs randomly and is represented by the matching function $M^C(\mathcal{B}, \mathcal{E})$, where $\mathcal{B}$ and $\mathcal{E}$ are the mass of banks and the mass of entrepreneurs respectively. The matching function satisfies the usual properties: it is increasing, concave in both arguments, and exhibits constant returns to scale. We denote the matching rate for entrepreneurs by $p(\phi) \equiv M^C(\mathcal{B}, \mathcal{E})/\mathcal{E} = M^C(1/\phi, 1)$, where $\phi \equiv \mathcal{E}/\mathcal{B}$ is the credit market tightness. Symmetrically, the matching rate for banks is given by $\phi p(\phi)$. When a banker and an entrepreneur match, they bargain bilaterally over the terms of the loan, where the contract specifies the flow repayment R that the entrepreneur will owe once production begins (note that R encompasses both the loan principal and interest). Finally, when the job separation shock s hits, the credit relationship is also terminated.[14]

[12] Although wages are often determined by bilateral bargaining in search-theoretic models of the labor market, we prefer to abstract from this mechanism here. Indeed, as shown by Wasmer and Weil (2004) and Petrosky-Nadeau and Wasmer (2013), the fixed wage assumption facilitates the identification and analysis of the theoretical mechanisms of the model in a clean and intuitive way. Highlighting the theoretical mechanisms between secondary financial markets and real economic variables is one of our main goals, hence this approach seems appropriate.

[13] Indeed, there is a lot of empirical evidence that bank lending to firms is subject to credit frictions. For a discussion see Gabrovski and Ortego-Marti (2025).

[14] We relax this assumption in the richer model of Section 3.

Loan-servicing costs and securitization. A bank which carries a loan with principal L on its books incurs loan-servicing costs equal to $\xi(L)$ per unit of the loan, with $\xi(L) = \tilde{\xi} L^{\epsilon}$. Thus, total loan-servicing costs are $\xi(L)R$, where R captures the annualized value of the loan that includes both the principal and negotiated interest. We impose $\tilde{\xi}, \epsilon > 0$, which ensures the concavity of the bank's optimization problem. Moreover, banks have the ability to securitize the loans: they split the original asset, which promises a flow repayment R until maturity, into R units of a new asset that repays a flow unit of the numeraire good until maturity. The bank optimally chooses what fraction of these securities to sell and keeps the remaining on its books, trading off the opportunity cost of the foregone yield and the benefit of saving on the loan-servicing costs. In the richer model of Section 3, we model the secondary loan market as an OTC market in the spirit of Duffie et al. (2005). For this section, however, we assume that the unit price of loan securities, P, is exogenously fixed and bounded above by $1/(r + s)$.[15]

Value functions. The life of a project begins with an entrepreneur searching for financing in the credit market. The discounted lifetime value of this activity is denoted by E_C, where

$$rE_C = -c + p(\phi)(E_V - E_C). \tag{1}$$

The entrepreneur pays the flow search cost c for every instant spent searching in the credit market. At rate $p(\phi)$, she finds financing and transitions to the labor market to search for a worker. The lifetime discounted value of searching for a worker is given by E_V, with

$$rE_V = q(\theta)[E_J(R) - E_V]. \tag{2}$$

Since the entrepreneur does not pay for any of the search costs in the labor market, E_V is comprised of the matching rate $q(\theta)$ and the capital gain the entrepreneur can expect after matching with a worker. This capital gain corresponds to the value of having a newly created job and being liable for a flow loan repayment R, $E_J(R)$, net of the value of having an open vacancy, E_V. The notation $E_J(R)$ makes explicit that the value of an operating job depends

[15] Fixing the price allows us to (i) obtain an analytical expression of the elasticity of the market tightness with respect to labor productivity in the spirit of Ljungqvist and Sargent (2017); (ii) analyze cleanly the direct effect of changes in the loan principal on banks' payoff without having to consider the general equilibrium effects on equilibrium asset supply in the secondary loan market.

on the negotiated repayment. Specifically, it is given by

$$rE_J(R) = y - w - R - sE_J(R). \tag{3}$$

The flow profits that the entrepreneur enjoys are given by the output y net of the wages w and the loan repayment R. At rate s the project is permanently terminated, the value of the job is lost, and the entrepreneur leaves the market.

The life of a loan begins with a bank looking to finance a new project. The value for a bank of being in this stage is denoted by B_C, given by

$$rB_C = -\kappa + \phi p(\phi)(B_V - B_C). \tag{4}$$

At rate $\phi p(\phi)$, the bank meets an entrepreneur and extends credit to her. In that event, the bank has to fund the labor market recruitment costs for a vacancy, which has a value B_V. The lifetime discounted value of financing a vacancy B_V is given by

$$rB_V = -\chi + q(\theta)\left[\max_{\tau\in[0,1]}\{B_J(\tau) + P(1-\tau)R\} - B_V\right]. \tag{5}$$

The bank has to finance the vacancy's search activities, hence it experiences a flow cost χ. At rate $q(\theta)$, the entrepreneur finds a worker and production begins. After that event, the bank experiences a capital gain due to being owed the loan repayment. The bank can securitize the repayment she is owed, R, optimally choosing the fraction $\tau \in [0,1]$ to keep on the books, while selling the fraction $(1-\tau)$ to investors in the secondary loan market at a price P per unit.[16] The bank's lifetime discounted value of keeping a fraction τ of the asset on the balance sheet, $B_J(\tau)$, is given by

$$rB_J(\tau) = [1 - \xi(\tau L)]\tau R - sB_J(\tau). \tag{6}$$

For a fraction τ of the asset kept on the books, the bank receives the flow repayment net of the loan-servicing costs until the underlying project is terminated at Poisson rate s.

[16]Formally, we assume that the bank unilaterally chooses τ, a decision that occurs after the negotiation of the flow loan repayment R with the entrepreneur. In equilibrium, the outcome of the negotiation, R, is consistent with the choice of τ. Outcomes would be identical if we had instead assumed that τ was negotiated jointly with R when the bank and the entrepreneur match.

Bargaining. The negotiated repayments the entrepreneur makes to the banker solve

$$R = \arg\max \left[B_V - B_C\right]^{\alpha_C} \left[E_V - E_C\right]^{1-\alpha_C}, \tag{7}$$

where $\alpha_C \in [0,1]$ is the bargaining power of the bank.

The evolution of unemployment. In our economy, unemployment evolves in the same way as in the baseline DMP model. The flow into the pool of unemployed is simply all employed workers $(1-\mathcal{U})$ times the separation rate s; the flow out of unemployment is the mass of unemployed $\mathcal{U}$ times the job-finding rate $\theta q(\theta)$. Formally,

$$\dot{\mathcal{U}} = s(1-\mathcal{U}) - \mathcal{U}\theta q(\theta). \tag{8}$$

2.2 Mechanisms

Banks' optimal portfolio choice. To begin with, we derive the optimal fraction of the loan banks choose to securitize, taking the size of the loan L and the repayment R as given. Substituting (6) into (5) leads to the following problem:

$$B_V = -\frac{\chi}{r+q(\theta)} + \frac{q(\theta)}{r+q(\theta)} R \left\{ \max_{\tau\in[0,1]} \{\tau \frac{1-\xi(\tau L)}{r+s} + P(1-\tau)\} \right\}.$$

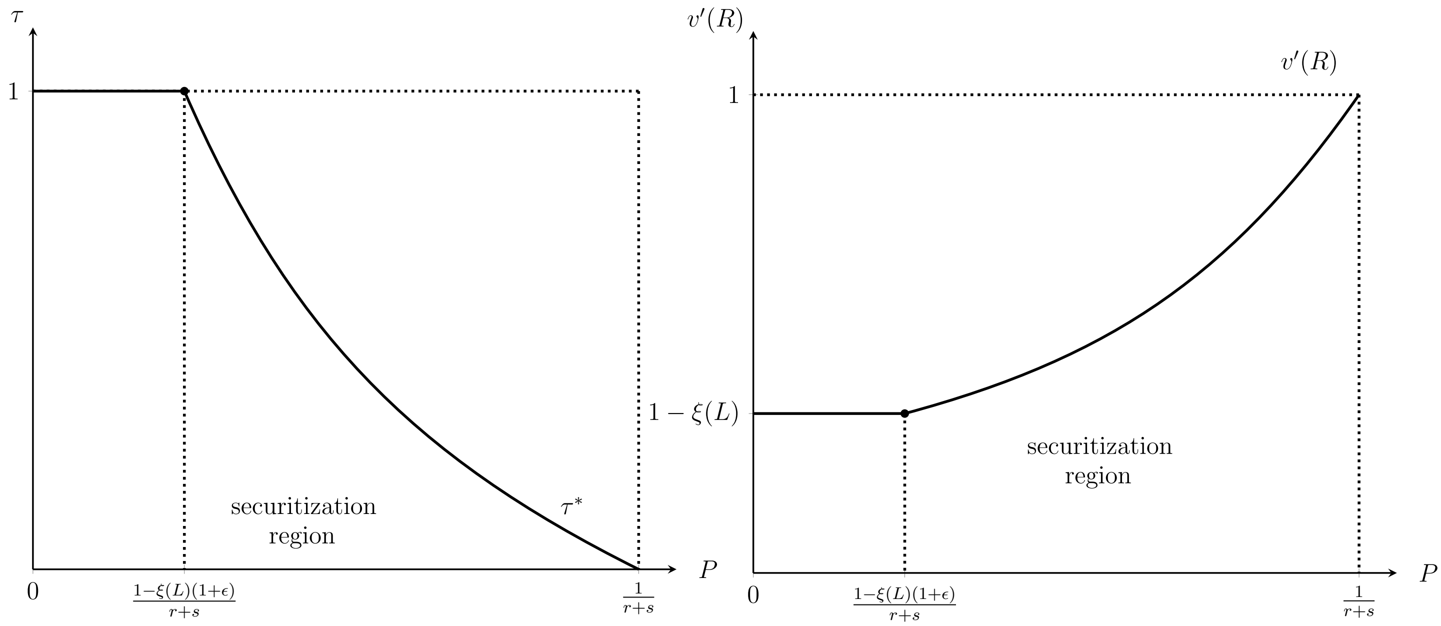
The solution for the optimal fraction of the asset the bank will keep on its books, τ^*, is given by the following expression and depicted graphically in Figure 1a:

$$\tau^* = \begin{cases} 1 & \text{if } P \leq [1-\xi(L)(1+\epsilon)]/(r+s), \\ \left[\frac{1-(r+s)P}{(1+\epsilon)\tilde{\xi}L^{\epsilon}}\right]^{\frac{1}{\epsilon}} & \text{if } [1-\xi(L)(1+\epsilon)]/(r+s) < P < 1/(r+s), \\ 0 & \text{if } P = 1/(r+s). \end{cases} \tag{9}$$

In words, if the secondary market price is too low compared to the loan-servicing costs, the bank keeps the whole asset on its books ($\tau^* = 1$). Symmetrically, if the securitization price is high enough, the bank securitizes the whole loan and does not keep any on its balance sheet ($\tau^* = 0$). In the intermediate case, the fraction τ^* is a decreasing function of both the secondary market asset price and the size of the loan. Substituting the intermediate τ^* in the cost function yields:

$$\xi(\tau^* L) = [1-(r+s)P]/(1+\epsilon). \tag{10}$$

That is, banks adjust their portfolios such that the asset price is the main determinant of loan-servicing costs at the optimum.



(a) Optimal portfolio choice

(b) Marginal utility

Figure 1: Bank optimal portfolio choice and marginal utility.
Panel (a) shows banks' optimal portfolio choice, τ^* as a function of the asset price P. For low levels of P the bank chooses to keep all of the asset on its books. As P increases, it enters the securitization region where some of the asset is offloaded. The higher the price the less of the asset is kept on the banks' balance sheet. When the price reaches $1/(r+s)$, the bank chooses to securitize all of the asset. Panel (b) depicts the resulting additional flow utility, $v'(R)$, from a marginal increase in repayment, R, as a function of the secondary market price, P. In the securitization region, as the price increases banks choose to offload more of the asset which allows them to save on loan-servicing costs. This leads to an increase in the marginal utility flow $v'(R)$. At $P = 1/(r+s)$ the bank securitizes all of the asset and $v'(R) = 1$.

A complementary way to understand banks' behavior is to focus on the additional flow utility the bank would receive from a marginal increase in repayment R. We denote this object by $v'(R)$, where $v(R) \equiv (r+s)[B_J(\tau^*)/R + (1-\tau^*)P]$. From the envelope theorem, we can express the marginal utility as: $v'(R) = \tau^*[1-\xi(\tau^* L)] + (1-\tau^*)P(r+s)$. Intuitively, the existence of a secondary market allows banks to save on loan-servicing costs which affects the marginal utility of an additional unit of repayment. To see this, we graph in Figure 1b the bank's marginal utility $v'(R)$ for different price levels, keeping the size of the loan fixed. When the price is too low, the bank keeps all of the loan on its books ($\tau^* = 1$) and, as a result, an increase in P does not affect the bank's loan-servicing costs, nor its marginal utility. Observe that in this non-securitization region, $v'(R)$ attains its lowest value. At the securitization cut-off $P = [1 - \xi(L)(1+\epsilon)]/(r+s)$, the marginal utility of keeping a unit of the loan on its books versus selling it to the secondary market are exactly equal. At that point, an increase in the price induces the bank to offload more of the loan, which lowers the loan-servicing costs: the slope $dv'(R)/dP = (1-\tau^*)(r+s)$ is positive, since $\tau^* \leq 1$. In the securitization region ($\tau^* < 1$), a higher price in the secondary market induces banks to securitize a larger fraction of the loan which, in turn, leads to a greater marginal utility $v'(R)$ due to the lower loan-servicing costs. Marginal utility $v'(R)$ attains its largest value of 1 when the bank securitizes the whole loan and eliminates the loan-servicing costs ($\tau^* = 0$). Overall, the existence of a secondary OTC market mitigates the size of loan-servicing costs and increases the surplus of the joint entrepreneur-bank venture.

Credit and labor market tightness. Given the bank's optimal choice τ^*, we can derive the equilibrium conditions which determine the credit and labor market tightness, θ and ϕ respectively, following the analysis in WW. We find this approach useful because our simple model environment is an extension of the WW economy. Comparing the two economies highlights the novel implications of our model in a transparent way. The first step is to properly manipulate the entrepreneurs' and banks' value functions. Using (3), the firm's flow value when it has a loan with repayment R is given by the discounted expected revenue net of wages and future loan repayments, i.e. $E_J(R) = (y-w-R)/(r+s)$. We can substitute this expression into (2) and substitute the optimal bank portfolio choice into (5) to derive:

$$E_V = \frac{q(\theta)}{r+q(\theta)} \frac{y-w-R}{r+s}, \tag{11}$$

$$B_V = \frac{q(\theta)}{r+q(\theta)} \left[\frac{R}{r+s} v'(R) - \frac{\chi}{q(\theta)} \right]. \tag{12}$$

Adding (11) and (12) yields the joint surplus of an entrepreneur-bank match (which also coincides with the value of a vacancy), denoted by Σ:

$$\Sigma = \underbrace{\frac{q(\theta)}{r+q(\theta)} \left[\frac{y-w}{r+s} - \frac{\chi}{q(\theta)} \right]}_{\text{surplus in WW}} - \underbrace{\frac{q(\theta)}{r+q(\theta)} [1 - v'(R)] \frac{R}{r+s}}_{\text{discounted loan-servicing cost}}. \tag{13}$$

Equation (13) allows for a direct comparison with the corresponding surplus equation (17) in Wasmer and Weil (2004). In both models, the principal of the loan just covers the discounted vacancy cost: $L = \chi/q(\theta)$. In WW, the surplus is a discounted value of the expected firm profits $(y-w)/(r+s)$ net of the labor search costs $\chi/q(\theta)$. In our economy, the surplus also includes the bank's loss of utility due to loan-servicing costs, as captured by the last term in the equation. Every unit of repayment R that is negotiated lowers the entrepreneur's utility by a unit. At the same time, however, the bank only receives $v'(R) \leq 1$ units of extra utility. Hence, each negotiated unit of repayment leads to a $1 - v'(R)$ units of loss in the joint entrepreneur-bank surplus. Over the lifetime of the loan this amounts to $[1 - v'(R)]R/(r + s)$ units of cumulative surplus loss. In contrast, the repayment R is a pure transfer from the entrepreneur to the bank in the WW economy, thus it does not affect the joint surplus. The surplus in our model converges to that in the WW economy when the price in the secondary market becomes high enough to incentivize the bank to securitize the entire loan (in which case $\tau^* = 0$ and $v'(R) = 1$). Again, access to a secondary market with a favorable price allows banks to mitigate the loan-servicing costs and increases the bank-entrepreneur surplus (i.e., the value of a vacancy).

Next, we characterize the repayment R as a function of the labor market tightness. Solving for the Nash Bargaining problem in (7) implies the following split of the surplus:

$$E_V = \frac{1 - \alpha_C}{1 - \alpha_C[1 - v'(R)]}\Sigma, \tag{14}$$

$$B_V = \frac{v'(R)\alpha_C}{1 - \alpha_C[1 - v'(R)]}\Sigma, \tag{15}$$

where E_V and B_V represent the surpluses of the entrepreneur and the bank, since $E_C = B_C = 0$ due to free entry. In the WW economy $v'(R) = 1$, hence the two parties split the surplus according to their respective bargaining powers. Once loan-servicing costs are introduced, the effective bargaining strengths of both the entrepreneur and the bank change to reflect this new feature. As $v'(R)$ decreases, the bank keeps a larger part of the loan on its books and receives a smaller part of the surplus: the higher loan-servicing costs put a larger burden on the match surplus from each additional unit of repayment and the bank has to settle for less (that is, for a given principal, the bank is not able to negotiate a higher interest rate on the loan).

Plugging in the expressions for E_V and B_V from (2) and (5) yields the equilibrium solution for the loan repayment:

$$R = \alpha_C(y - w) + \frac{(1 - \alpha_C)(r + s)}{v'(R)}\frac{\chi}{q(\theta)}. \tag{16}$$

The equilibrium loan repayment is the weighted average of two terms. The first is the firm's net revenue minus the entrepreneur's outside option (recall that free entry drives the entrepreneur's search value E_C to zero). This term represents the maximum repayment the entrepreneur could make while keeping a non-negative surplus. The second term is the principal of the loan, $\chi/q(\theta)$, divided by the bank's marginal utility. That term can be interpreted as the minimum repayment the entrepreneur could make to leave the banker whole. Because both the banker and the entrepreneur have positive bargaining power, the negotiated repayment falls in between the minimum and the maximum values it could take. When $v'(R) < 1$, the repayment is higher than that in the WW economy for a given labor market tightness: intuitively, bargaining imposes that the entrepreneur and the bank share the burden of the loan-servicing costs, effectively akin to a higher interest rate.

The last step of the WW methodology consists of deriving the EE and BB loci, which operate in a similar fashion as the job-creation condition in the benchmark DMP model (Pissarides, 2000) to determine equilibrium labor and credit market tightness. The EE locus equalizes the entrepreneur's cost of searching for credit with the expected value of obtaining such credit. Free entry of entrepreneurs ensures this condition holds: were search costs less than their expected value, more entrepreneurs would enter the market, increasing competition for banks, and thereby driving the cost of credit up until the net value of entering is zero. Similarly, the BB locus equalizes the cost for a bank to finance a project with the expected value of providing such financing—and the free entry of bankers ensures that this condition holds in equilibrium.

Algebraically, free entry applied on the Bellman equations (2) and (5) yields expressions for E_V and B_V as functions of credit market tightness:

$$E_V = c/p(\phi), \tag{17}$$

$$B_V = \kappa/[\phi p(\phi)]. \tag{18}$$

We substitute R into (11) and (12) and equate them with the expressions in (17) and (18) to derive the EE and BB loci:

$$\text{EE}: \quad \frac{c}{p(\phi)} = (1-\alpha_C)\frac{q(\theta)}{r+q(\theta)}\left[\frac{y-w}{r+s} - \frac{1}{v'(R)}\frac{\chi}{q(\theta)}\right], \tag{19}$$

$$\text{BB}: \quad \frac{\kappa}{\phi p(\phi)} = v'(R)\alpha_C\frac{q(\theta)}{r+q(\theta)}\left[\frac{y-w}{r+s} - \frac{1}{v'(R)}\frac{\chi}{q(\theta)}\right]. \tag{20}$$

These two equations jointly determine θ and ϕ in equilibrium conditional on P. Using the language of Wasmer and Weil (2004), BB represents a credit creation condition and EE a job creation condition. Moreover, we follow WW and represent the system of equations

(19) and (20) graphically as a pair of contour lines in the (θ, ϕ) plane along which banks and entrepreneurs make zero profit due to free entry (Figure 1 in their paper). As Figure 2 shows, both in the WW model and our model, EE has a positive and BB has a negative slope: as ϕ decreases, θ has to increase to keep the bank's profit constant (BB curve) or, symmetrically, θ has to decrease to keep the entrepreneur's profit constant (EE curve). The equilibrium of the model is given by the intersection of the two curves.

The impact of loan-servicing costs and secondary loan trading on tightness. Having solved for the model equilibrium, we now compare the levels of credit and labor market tightness in our economy with their corresponding levels in two alternative environments: i) the WW economy and ii) a no-securitization (NS) economy where banks have to keep the whole loan on their books ($\tau = 1$). Again, this is a useful comparison because the WW economy corresponds to our economy with neither loan-servicing costs nor a secondary loan market. To establish this connection, we compare the equilibrium conditions (19) and (20) to those in the WW economy (equations (15) and (16) in their paper): the only difference is the term $v'(R)$, the marginal utility the bank receives from an extra unit of repayment. This marginal utility reflects the novel elements of our model with respect to the WW model, namely the loan-servicing costs and the banks' ability to securitize loans. On the one hand, the loan-servicing cost tends to lower $v'(R)$ because it makes it relatively more expensive for the entrepreneur to compensate the bank for the credit it has extended, which, in turn, reduces the joint surplus of the bank-entrepreneur venture. On the other hand, a higher secondary market price tends to raise $v'(R)$ because it allows banks to offload part of the loan and save on loan-servicing costs. Note that the latter channel is absent in the NS economy, since banks do not have access to a secondary loan market. Intuitively, our model lies somewhere in between the NS and WW economies: even though both our and the NS models feature loan-servicing costs, the existence of a secondary market brings our model closer to the WW economy because it helps banks alleviate the effects of the loan-servicing costs. The exact distance from each one of the two extremes is determined by the banks' optimal choice of τ^*: if the secondary market price is low and $\tau^* = 1$, our model coincides with the NS economy; if the secondary market price is high and $\tau^* = 0$, loan-servicing costs disappear and our model coincides with the WW economy.

We show the impact of these mechanisms on the equilibrium credit and labor market tightness step by step, starting with the labor market. Graphically, the existence of loan-servicing costs shifts both the EE and BB loci to the left compared to the WW model. To

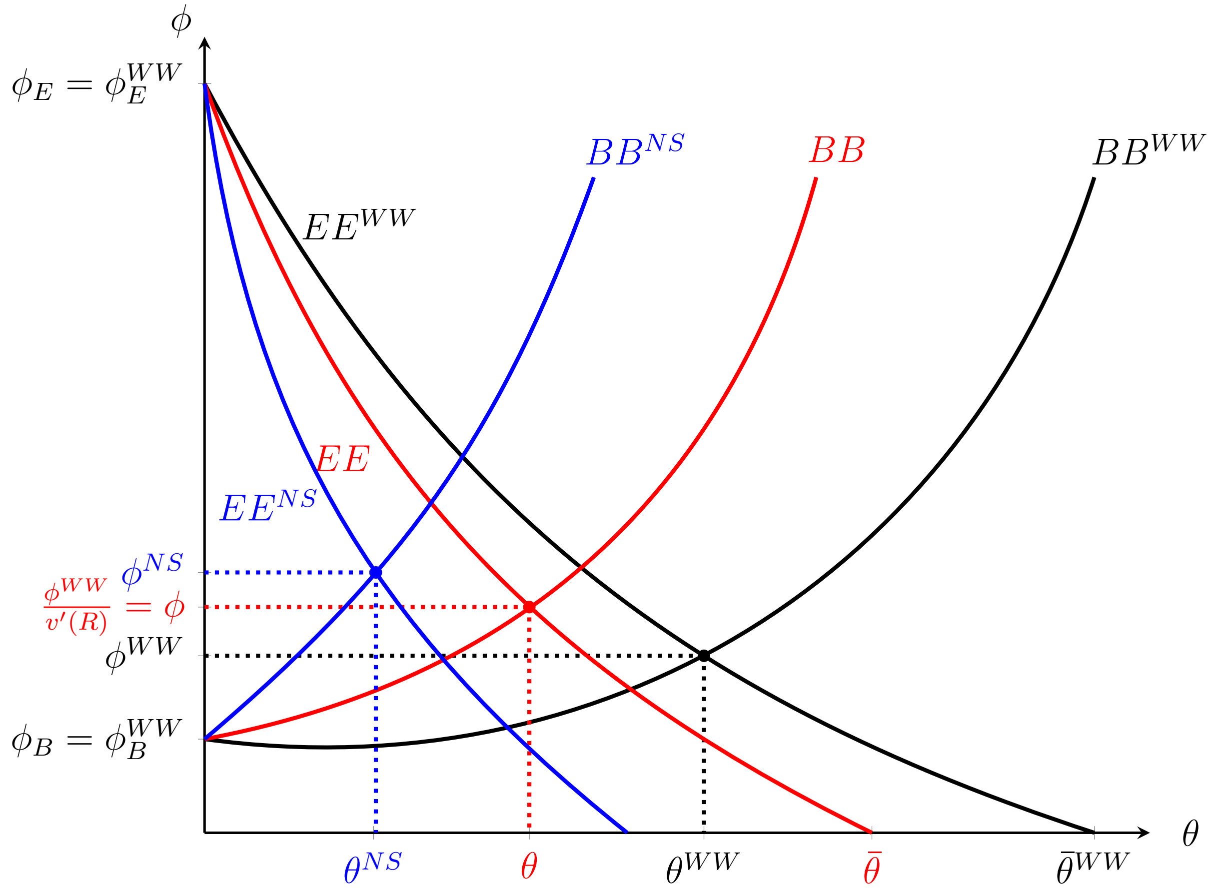


Figure 2: Equilibrium labor and credit market tightnesses.

Figure 2 shows the equilibrium credit and labor market tightnesses in our economy (red), in the Wasmer and Weil (2004) economy (black), and in an economy without the option to securitize loans, i.e. $\tau = 1$ (blue). Equilibrium in our economy occurs at the intersection of the EE and BB loci given by (19) and (20). A higher labor market tightness implies a longer time to recruit a worker, which in turn translates to a higher loan principal. Thus, it is more expensive for banks to finance the joint bank-entrepreneur venture. They need to be compensated with a higher matching rate in the credit market, resulting in an upward-sloping BB locus. The entrepreneur also endures part of the higher funding costs (through Nash bargaining), so they require a higher match rate as well, and the EE locus is downward sloping. The EE^{WW} and BB^{WW} are the loci in the Wasmer and Weil (2004) economy, which can be derived by plugging in $v'(R) = 1$ in (19) and (20) in our model. The EE^{NS} and BB^{NS} loci depict the economy when banks do not have the option to securitize loans and can be derived by plugging $v'(R) = 1 - \xi(L)$ in (19) and (20).

explain these shifts, let us begin with the EE^{NS} locus, as defined by (19) under $\tau = 1$. The relative bargaining power of the entrepreneur remains unaffected by the existence of loan-servicing costs, hence the only change in this locus compared to the WW model comes from the higher burden of the search costs (the $1/v'(R)$ term in the bracket). For positive values of θ, the larger search costs translate into larger loans to entrepreneurs, since these costs are financed by bank credit. As the principal of the loan $(\chi/q(\theta))$ increases, the bank faces higher loan-servicing costs $[1 - v'(R)]R$ which shift the EE^{NS} locus to the left of that of the WW economy, denoted with EE^{WW}. Notice that for $\theta \to 0$, the search costs approach 0 as well, hence the EE^{NS} locus converges to EE^{WW}. Similarly, as $\theta \to 0$, the BB^{NS} locus converges to that of the WW economy, denoted with BB^{WW}. For positive values of θ, the total match surplus Σ decreases faster than that in the WW economy (equation (13)) and the bank's relative bargaining power, $v'(R)\alpha_C$, decreases as well. This shifts the BB^{NS} locus to the left of BB^{WW}. In total, this graphical analysis implies that labor market tightness in an economy with loan-servicing costs is smaller than in the WW economy, $\theta^{NS} < \theta^{WW}$. We provide an analytical proof of that result in Appendix A.

The graphical analysis does not allow for a clear-cut comparison between the magnitude of credit market tightness in the NS economy vis-a-vis the WW model. However, we can easily show that ϕ^{NS} is larger in the NS economy than in the WW economy (as depicted in Figure 2). To begin with, plugging (17) and (18) in the Nash bargaining protocol yields the following expression for the credit market tightness:

$$\phi = \frac{1}{v'(R)} \frac{(1 - \alpha_C)}{\alpha_C} \frac{\kappa}{c} = \frac{\phi^{WW}}{v'(R)}, \tag{21}$$

where we have substituted in the expression for credit market tightness in the WW model, ϕ^{WW} (Proposition 1 in their paper). Because of loan-servicing costs, the marginal utility $v'(R)$ is strictly less than one. Consequently, the equilibrium tightness in the credit market is larger than in the WW model. As (13) under $\tau = 1$ shows, the surplus of a bank-entrepreneur match in the NS economy is lower than in the WW economy due to the existence of loan-servicing costs. This lowers entry for both banks and entrepreneurs. However, the less-than-unit marginal utility also lowers the bank's effective bargaining power (equations (14) and (15)). Thus, banks have an even lower incentive to enter, which results in a greater credit market tightness relative to the WW economy. In summary, loan-servicing costs tend to depress the labor market tightness because they reduce the joint entrepreneur-bank venture surplus. Moreover, the bank tends to carry a higher fraction of the loan-servicing cost burden, thus loan-servicing costs tighten credit, i.e., ϕ is higher.

When banks have the option to securitize loans, we arrive at our benchmark economy. Graphically, we depict it under the EE and BB loci in Figure 2. Intuitively, the option to securitize loans increases the efficiency of the credit market. Banks are able to offload some of the loan, which enables them to reduce their loan-servicing costs. This is captured by an increase in $v'(R)$. Since the only difference between the NS and the WW economies is the less-than-unit marginal utility $v'(R)$ in the NS economy, it follows that the presence of a secondary loan market places the EE and BB loci between those of the NS and WW economies. If the asset price is high enough, $P = 1/(r+s)$, banks sell the entire loan. This eliminates their loan-servicing costs and pushes the equilibrium in our economy to coincide with that of the WW economy. Conversely, if the price is too low, $P \leq [1-\xi(L)(1+\epsilon)]/(r+s)$, banks keep the entire loan on their books and the equilibrium in our economy coincides with that in the NS economy. Thus, we can conclude that $\theta^{NS} \leq \theta \leq \theta^{WW}$ and $\phi^{WW} \leq \phi \leq \phi^{NS}$. Just like in the DMP model, equilibrium unemployment in our model is given by the Beveridge curve $u = s/[s+\theta q(\theta)]$, and thus is strictly decreasing in θ. Hence, we can rank the steady-state unemployment levels in the three economies as $u^{WW} \leq u \leq u^{NS}$.

2.3 Loan-servicing costs as an automatic stabilizer

Finally, we study how the existence of loan-servicing costs and a secondary loan market affects the propagation of labor productivity shocks. As Wasmer and Weil (2004) show, credit frictions generate a financial accelerator that amplifies the impact of productivity shocks. The presence of loan-servicing costs and a secondary loan market in our model has important implications for the model's response to real shocks. On one hand, loan-servicing costs dampen the financial accelerator, thereby acting as an automatic stabilizer that reduces the economy's response to shocks in comparison to the WW model. On the other hand, access to a secondary loan market mitigates this stabilizing effect. Hence, the simplified model economy with a secondary market exhibits *smaller* responses to productivity shocks than the WW economy but *larger* responses than the NS economy.

To provide an analytically tractable proof of these results, we follow the methodology of Ljungqvist and Sargent (2017) to derive the elasticity of labor market tightness with respect to labor productivity. As shown by Ljungqvist and Sargent (2017) (equation (44) in their paper), the elasticity of θ with respect to y in the WW economy is given by

$$\varepsilon_{\theta,y}^{WW} = \frac{1}{\eta_L} \frac{y}{y - w - s\frac{c}{(1-\alpha_C)p(\phi)}}, \tag{22}$$

where η_L is the elasticity of the matching function with respect to unemployment (we set $r = 0$ as in Wasmer and Weil (2004) to facilitate an easier comparison between the two models).[17] In the language of Ljungqvist and Sargent (2017), the elasticity is equal to the

[17] It is straightforward to derive this equation by substituting $v'(R) = 1$ and $r = 0$ into (19), totally differentiating with respect to y, and using the expression for ϕ from (21). Alternatively, setting $v'(R) = 1$,

inverse of the elasticity of the labor market matching function $1/\eta_L$ times the inverse of the fundamental surplus. The smaller the fundamental surplus, the larger the response of the market tightness to changes in labor productivity. In the WW model, the fundamental surplus is the worker output net of wages and the annualized search costs faced by the entrepreneur. These search costs reduce the fundamental surplus (as they lower the surplus of a bank-entrepreneur match) and amplify the impact of productivity shocks; that is, search costs in the credit market generate a financial accelerator.

The calculation of the corresponding $\varepsilon_{\theta,y}$ elasticity in our model is more involved because the marginal utility $v'(R)$ is also a function of labor market tightness θ (as θ affects the loan principal through hiring costs). Importantly, the elasticity of $v'(R)$ with respect to θ is negative: a tighter labor market increases hiring costs, which, in turn, raise the loan principal and the loan-servicing costs. The higher loan-servicing costs lower the bank's marginal utility $v'(R)$, which implies that $\varepsilon_{v'(R),\theta} < 0$. To calculate $\varepsilon_{\theta,y}$ in our model, we totally differentiate (19) and (21) with respect to y:

$$\varepsilon_{\theta,y} = \frac{1}{\eta_L} \frac{y}{y - w - \frac{sc}{(1-\alpha_C)p(\phi)} - \frac{\varepsilon_{v'(R),\theta}}{\eta_L}[y - w - (1-\eta_C)\frac{sc}{(1-\alpha_C)p(\phi)}]}. \tag{23}$$

Given that $\varepsilon_{v'(R),\theta} < 0$, the last term in the fundamental surplus is positive. Thus, the fundamental surplus is higher than that of the WW model, which implies that the impact of real shocks is smaller in our model than in the WW economy. The last term in the fundamental surplus represents the automatic stabilizer, whose magnitude determines the difference in the responses between the two models. A back of the envelope calculation under reasonable parameter values (our calibration from Section 4) implies that the magnitude of the automatic stabilizer is sizable: $\varepsilon_{\theta,y}^{WW} = 7.8$, whereas $\varepsilon_{\theta,y} = 6.3$. For comparison, the corresponding elasticity in the baseline DMP model is 4.2, implying that the automatic stabilizer can dampen up to half of the extra volatility induced by the financial accelerator.

It is instructive to dig deeper into the elasticity $\varepsilon_{v'(R),\theta}$ and provide its algebraic expression. Let us begin with the case when the secondary loan market price is too low and banks do not securitize any loans (that is, the NS economy). Then, $v'(R) = 1 - \xi(L)$ and $\varepsilon_{v'(R),\theta} = -\eta_L \xi(L)\epsilon/(1 - \xi(L))$. In this case, the elasticity $\varepsilon_{v'(R),\theta}$ reaches its maximum (in absolute value) and the impact of the automatic stabilizer is maximized. Next, assume that the secondary market price is high enough that at least a fraction of the loans

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$r = 0$, and using (21) implies that the k term in equation (44) of Ljungqvist and Sargent (2017) is equal to $sc/[p(\phi)(1-\alpha_c)]$.

are securitized. Since P is fixed, the impact of an increase in θ on $v'(R)$ is captured by $\varepsilon_{v'(R),\theta} = -\eta_L \tau\xi(\tau L)\epsilon/[\tau(1-\xi(\tau L)) + (1-\tau)P(r+s)]$. This expression is analogous to the no securitization case but of a smaller magnitude since $\tau\xi(\tau L)\epsilon/[\tau(1-\xi(\tau L))+(1-\tau)P(r+s)] < \tau\xi(\tau L)\epsilon/[\tau(1-\xi(\tau L))] < \xi(L)\epsilon/(1-\xi(L))$. Intuitively, following an increase in labor productivity, the principal amount of the loan increases and raises the banks' loan-servicing costs. Since banks sell part of the loan, though, they have a tool to mitigate the increased costs. Hence, for a given loan amount, $v'(R)$ does not decrease as much as in the no securitization case and the impact of the automatic stabilizer is smaller. That is, the NS economy with loan-servicing costs but without a secondary loan market features smaller responses to productivity shocks (larger automatic stabilizers) than our benchmark model with loan-servicing costs and a secondary loan market. In our back of the envelope calculation, $\varepsilon_{\theta,y} = 6.3$ with a secondary loan market and $\varepsilon_{\theta,y} = 5.9$ without it. In sum, the presence of a secondary loan market amplifies the economy's response to productivity shocks.

We stress that the preceding analysis applies to a partial equilibrium setting. When one analyzes the general equilibrium effects of a productivity shock on the economy there are two additional effects at play. First, for a given set of parameter values, the credit market tightness ϕ in our economy is larger than that in the WW world. Thus, in our economy the annualized credit search costs for the entrepreneur are larger, which tends to amplify the magnitude of business cycle fluctuations. Moreover, the presence of a secondary loan market mitigates this effect as it helps loosen credit conditions for entrepreneurs. Second, we have kept the asset price P fixed, even though a productivity shock affects the asset supply which, in turn, should affect asset prices. As we show in Section 5, this simplification is a good approximation to a frictional secondary market where prices do not respond much to changes in supply. However, in an economy with a frictionless secondary market prices adjust much more following a productivity shock. As a result, the banks' marginal utility $v'(R)$ is more volatile than in the NS economy, which ultimately leads to a lower magnitude of business cycle fluctuations. We explore these effects quantitatively in Section 5.

3 The Calibrated Economy

To gauge the quantitative importance of loan-servicing costs and banks' ability to securitize and sell loans on a secondary market, we develop a richer model that incorporates several key extensions of the environment presented in Section 2. First, we fully model the secondary loan market in the spirit of Duffie et al. (2005). This allows us to study the quantitative properties of a general equilibrium model where the price and the supply of loans on the secondary market are both endogenous, as well as to gauge the impact of financial frictions on the real economy. Second, we introduce the need for financing capital expenditures. Both newly-formed firms and existing firm-worker pairs require capital to produce, hence incumbent firms require external financing as well. Thus, in our richer model new firms require vacancy loans to fund both hiring and capital expenditures, whereas incumbent firms require capital replacement loans to fund capital expenditures only.[18] These features are both realistic and potentially relevant to capture quantitatively when calibrating the model to the data. In the remainder of this section, we provide a brief description of this richer environment, highlighting its differences with the simple model of Section 2. In Appendix B, we provide the rest of the model elements and derive the steady-state equilibrium.

3.1 The markets for credit and labor

Capital and the need for financing for incumbents. Most of the environment relating to the labor and credit markets is the same as in Section 2. A major point of departure is the introduction of capital. In this richer economy, entrepreneurs must hire a worker *and* purchase a unit of capital, costing F, in order to produce. The capital is embodied in the job: if the worker and the firm separate, the capital is destroyed. The firm and worker separate at rate s as before, but now we allow loans to mature at a different rate m_C. Thus, it is possible for the entrepreneur to pay off the loan while she is still attached to the worker. Provided that the firm does not already have an existing loan, its capital is hit by a negative depreciation shock with an exogenous Poisson rate σ. If the firm has an existing loan, its capital is not subject to depreciation. This assumption keeps the model tractable — firms can have at most one active loan. Moreover, it is also consistent with the view of banks as monitors — as we have detailed in Section 1.1, banks exert a considerable effort ensuring that firms are maintaining their collateral and good business practices in general — which would incentivize firms to maintain their capital and/or protect it with insurance (Gustafson et al., 2021). Once a firm's capital experiences a depreciation shock, it enters a state of higher risk of obsolescence: capital becomes completely inoperable at a Poisson rate d. If the firm fails to take a new loan to replace its capital before then, production stops and the match is destroyed. If the firm can secure financing, however, it continues production while repaying

[18] Petrosky-Nadeau and Wasmer (2013) reinterpret the firm as an entity with several marginal investment projects, each requiring labor and financing from a bank in a credit market with frictions. Under their interpretation, the relevant financial costs affect all firms, not only new firms. Their model does not feature capital though, hence all firms receive the same level of credit.

the new loan.

Value functions. The Bellman equations for entrepreneurs who are looking for financing, E_C, and looking for a worker, E_V, are still given by (1) and (2). However, once production starts, the firm may suffer either a worker separation shock or a loan maturity shock. Hence, the Bellman equation for E_J is now given by

$$rE_J(R_i) = y - w - R_i + s\left[E_N(R_i) - E_J(R_i)\right] + +m_C[E_J^0 - E_J(R_i)], \tag{24}$$

where E_J^0 denotes the value of a firm that is matched with a worker but has no existing loan, $E_N(R)$ is the value of a firm that has separated with a worker but has an existing loan, and $R_i \in \{R_V, R_E\}$. We use the notation R_V to denote the repayment a bank negotiates with an entrepreneur looking to fill a vacancy and R_E the repayment it negotiates with an entrepreneur in an existing match. There are two differences between equation (24) and its counterpart equation (3) from Section 2. First, the loan principals and outside options differ for incumbent versus newly-formed firms and this is reflected in the different negotiated repayments R_E and R_V. Second, there are two new states that did not exist in the simple model of Section 2: firms now may be either separated from the worker with a loan to repay or matched to a worker without a loan. In the former case, the entrepreneur has to repay the loan until maturity that yields the following lifetime discounted value:

$$rE_N(R_i) = -R_i - m_C E_N(R_i). \tag{25}$$

In the latter case, the lifetime discounted value of a project is:

$$rE_J^0 = y - w + \sigma(E_J^F - E_J^0) - sE_J^0. \tag{26}$$

The entrepreneur enjoys the flow profit $y - w$ until the project is terminated at rate s. In that event, the value of the job is lost and the entrepreneur leaves the market. Alternatively, the firm's capital may depreciate at rate σ. In that event, the firm loses its value E_J^0 and transitions to the state of a filled job looking for credit with value E_J^F. This value is, in turn, given by the Bellman equation:

$$rE_J^F = y - w + p(\phi)[E_J(R_E) - E_J^F] - (s + d)E_J^F. \tag{27}$$

The firm-worker match can still produce output, but the capital is in a depreciated state and the project faces the risk of being terminated at the higher rate $s + d$. At rate $p(\phi)$, the firm is matched with a bank that is willing to extend credit. In that event, the firm transitions to producing with non-depreciated capital, but is burdened by the loan repayment R_E.

We now turn to the Bellman equations for the value of the bank at different model stages. Let us first focus on the stage at which the bank has an existing loan. Since loans can mature at a time different than the worker and the firm separate, the Bellman for $B_J(\tau)$ is

$$rB_J(\tau_i) = [1 - \xi(\tau_i L_i)]\tau_i R_i - m_C B_J(\tau_i). \tag{28}$$

The only differences compared to the corresponding equation (6) from the simplified model are the rate at which the loan matures, m_C, as well as the fact that the loan amount, L_i, and the fraction that the bank chooses to keep on its books, τ_i, both depend on whether this is a vacancy creation loan or a loan to an incumbent firm. Next, we proceed with the value of a bank that is matched with an entrepreneur looking for a worker. Since firms need capital to operate, the bank has to extend a larger line of credit. Thus, its value is now given by

$$rB_V = -\chi + q(\theta) \left[\max_{\tau \in [0,1]} \{B_J(\tau_V) + P(1 - \tau_V)R_V\} - F - B_V \right]. \tag{29}$$

Compared to the corresponding Bellman equation in our simplified model, (5), the difference is that now banks have to finance the capital expenditure costs F in addition to the vacancy costs χ. Lastly, we turn to the first stage of the matching process: banks looking for credit opportunities. In the extended model, incumbent firms look for financing as well; hence, the bank may match with either a new firm looking for a vacancy loan or an incumbent firm looking for a capital financing loan. This yields the following Bellman equation:

$$rB_C = -\kappa + \phi p(\phi) \left\{ (1 - \pi)(B_V - B_C) + \pi \left[\max_{\tau_E \in [0,1]} \{B_J(\tau_E) + P(1 - \tau_E)R_E\} - F - B_C \right] \right\}. \tag{30}$$

At rate $\phi p(\phi)$, the bank meets with an entrepreneur and extends credit to her. With probability $1 - \pi$ the entrepreneur is a new entrant, so the bank has to fund the labor market recruitment costs in addition to capital, which has a value B_V. With the complement probability, the bank meets an entrepreneur who is matched with a worker but needs financing to replace her depreciated capital. In that event, the banker finances the costs of capital acquisition F and gets to securitize the loan into R_E pieces. It is easy to see that the corresponding Bellman equation (4) from the simplified model in Section 2 is a special case of equation (30) with $\pi = 0$, that is when there are no meetings with incumbent firms.

3.2 The secondary loan market

As in the simplified model from Section 2, banks securitize their loans and optimally choose what fraction of them to keep on their books and what fraction of them to sell at price P. In our richer environment, this price is endogenously determined in a secondary loan market. We model this market as an OTC market in the spirit of Duffie et al. (2005). There is an exogenously fixed mass of investors denoted by $\mathcal{L}$ who can either hold 0 or 1 unit of the asset. Trade takes place through the help of dealers: at rate λ, an investor meets with a dealer who has access to a perfectly competitive inter-dealer market. The dealer can execute buy and sell orders for the investor in exchange for a fee which the two parties bargain over. The dealer executes these orders by trading in the inter-dealer market. In that market, the price of the asset is P and it is set such that the order flows for buy and sell orders are equated. Thus, the inter-dealer market is the same as the market for newly-securitized loans. One departure we make from Duffie et al. (2005) is that we allow for infinitely many investor types distributed according to a continuous CDF $G(\delta)$. This description of an OTC market is standard in the search-theoretic literature.

Value of an investor. The lifetime discounted value of holding one unit of asset, for an investor of type δ, is denoted $V_1(\delta)$ and is given by

$$rV_1(\delta) = \delta + \gamma \int [V_1(\delta') - V_1(\delta)] \mathrm{d}G(\delta') + \lambda \max\{B(\delta) - \Delta V(\delta), 0\} - m_C \Delta V(\delta). \tag{31}$$

When the investor has the asset, she enjoys the utility flow δ, which captures her beliefs about the asset quality, as well as liquidity and hedging needs. At rate γ, the investor draws a new δ' from the type distribution. If an investor meets a dealer, she could trade the asset at the negotiated bid price, $B(\delta)$. She does so if the bid price is higher than her reservation value $\Delta V(\delta) \equiv V_1(\delta) - V_0(\delta)$. In that event she receives the transfer, but loses her reservation value, i.e. she becomes an investor with no asset. This also happens if the loan matures, an event that occurs at rate m_C. The Bellman of having no asset is $V_0(\delta)$:

$$rV_0(\delta) = \gamma \int [V_0(\delta') - V_0(\delta)] \mathrm{d}G(\delta') + \lambda \max\{\Delta V(\delta) - A(\delta), 0\}. \tag{32}$$

The interpretation is similar: the investor can experience a preference shock or she can meet a dealer. When the latter event happens she can purchase the asset at the negotiated ask price, $A(\delta)$, or choose to remain with zero asset holdings.

Laws of motion. Next we turn to the laws of motion for the investor types. Given the structure of the secondary market, it is straightforward to show that there exists a reservation type δ^* such that investors of type δ^* are indifferent between holding the asset or not, investors of type $\delta > \delta^*$ who do not hold the asset buy it when they meet a dealer, and investors of type $\delta < \delta^*$ who hold the asset sell it when they meet a dealer. Let $g(\delta)$ denote the density of customers of type δ, and $\psi_0(\delta)$ and $\psi_1(\delta)$ denote the densities of investors with type δ that respectively do and do not have the asset. Then,

$$g(\delta) = \psi_0(\delta) + \psi_1(\delta), \tag{33}$$

$$\dot{\psi}_1(\delta) = \lambda\psi_0(\delta)\mathbb{I}_{\delta\geq\delta^*} + \gamma\left[\int \psi_1(\delta')d\delta'\right]g(\delta) - \lambda\psi_1(\delta)\mathbb{I}_{\delta<\delta^*} - \gamma\psi_1(\delta). \tag{34}$$

The first equation simply formalizes that any investor either holds or does not hold the asset. The second equation is the law of motion for the density of investors of type δ holding the asset. For any δ, there is a positive flow into that state from investors who already held the asset with a different preference type and switched to type δ following a preference shock (second term). There is a corresponding negative flow from investors holding the asset who used to be of type δ but now have a different preference type δ' (fourth term). When $\delta \geq \delta^*$ there is an additional positive flow from investors of type δ who previously did not hold the asset but matched with a dealer, allowing them to purchase it (first term). Conversely, when $\delta < \delta^*$, there is a negative flow from investors of type δ who previously had the asset and met with a dealer, allowing them to offload it (third term). Lastly, all of the asset supply, $\mathcal{A}$, must be held by some investor, adding the constraint $\int \psi_1(\delta)\mathrm{d}\delta = \mathcal{A}$. Combining these equations yields the following investor density functions in steady state:

$$\frac{\psi_1(\delta)}{g(\delta)} = \begin{cases} \frac{\gamma}{\lambda+\gamma+m_C}\mathcal{A} & \text{if } \delta < \delta^*, \\ \frac{\gamma}{\lambda+\gamma+m_C}\mathcal{A} + \frac{\lambda}{\lambda+\gamma+m_C} & \text{if } \delta \geq \delta^*. \end{cases} \tag{35}$$

Bargaining. The bid and ask prices in the secondary loan market as well as the repayments in the credit market are determined by Nash Bargaining. Let the dealer's bargaining power be α_D. Then, the bid and ask prices solve the Nash products given below:

$$B(\delta) = \arg\max\left[B - \Delta V(\delta)\right]^{1-\alpha_D}\left[P - B\right]^{\alpha_D}, \tag{36}$$

$$A(\delta) = \arg\max\left[\Delta V(\delta) - A\right]^{1-\alpha_D}\left[A - P\right]^{\alpha_D}. \tag{37}$$

The description of the secondary loan market closes the model. Since our interest is in the quantitative properties of the model, we do not characterize the equilibrium here. Instead, we proceed by calibrating the model to the data and examining its numerical properties in Sections 4 and 5. A full characterization of the equilibrium is provided in Appendix B.

4 Calibration

We calibrate the model at a monthly frequency. Several parameters are calibrated externally to their direct empirical counterparts or by following the literature. We set the discount rate r to 0.0042, consistent with an annual interest rate of 5%. The exogenous wage $\bar{w}$ is set to 0.667 to match a labor share of two thirds (Gollin, 2002). Next, the maturity rate for loans, m_C, is set to 0.0278 to match the effective life of a typical loan in the secondary loan market (Saunders et al., 2025). Regarding matching functions, we follow Shimer (2005) for the labor and Petrosky-Nadeau and Wasmer (2013) for the credit market. In both papers, the matching function is Cobb-Douglas: $M^L(\mathcal{U}, \mathcal{V}) = \mu_L \mathcal{U}^{\eta_L}\mathcal{V}^{1-\eta_L}$ and $M^C(\mathcal{B}, \mathcal{E}) = \mu_C \mathcal{B}^{\eta_C}\mathcal{E}^{1-\eta_C}$. Shimer (2005) calibrates the elasticity $\eta_L = 0.72$, while Petrosky-Nadeau and Wasmer (2013) work with a symmetric elasticity of $\eta_C = 0.5$.

Parameter	Description	Value	Source/Target
r	Discount Rate	0.0042	5% Annual discount rate
$\bar{w}$	Wage	0.667	Gollin (2002)
m_C	Maturity Rate	0.0278	Saunders et al. 2025
η_L	Labor Market Matching Elasticity	0.72	Petrosky-Nadeau and Wasmer (2013)
η_C	Credit Market Matching Elasticity	0.5	Petrosky-Nadeau and Wasmer (2013)
$G(\delta)$	Distribution of Investor Valuations	$\mathcal{U}[\underline{\delta}, \bar{\delta}]$	Hugonnier et al. (2020)
y	Firm-Worker Match Output	1	Normalization
$\mathcal{L}$	Measure of Investors	1	Normalization
$\underline{\delta}$	Lower Bound of Investors' Valuations	0	Normalization

Table 1: Externally Calibrated Parameters

Turning to the OTC parameters, we impose that the distribution of asset valuations in the OTC market, G, is uniform, as in Hugonnier et al. (2020). Finally, we normalize the following variables: i) y, the output of a firm-worker match, to 1; ii) $\mathcal{L}$, the measure of investors in the OTC market, to 1; and iii) $\underline{\delta}$, the lowest possible investor valuation in the OTC market, to 0. The externally calibrated parameters are collected in Table 1.

Parameter	Description	Value	Target	Data
Secondary loan market block				
			Moments using micro-level evidence	
ϵ	Loan-servicing cost elasticity	1.0260	Credit-shock employment drop	-2.38%
$\tilde{\xi}$	Loan-servicing cost scale	0.1554	Bank discount for securitized loans	18 bps
α_D	Dealers' bargaining power	0.9959	Bank discount for liquid loans	88 bps
γ	Investor valuation drift	3.4227	Bid/Ask spread	87 bps
λ	Meeting rate	0.0321	Turnover	70%
$\bar{\delta}$	Maximal investor valuation	1.2712	Spread-to-maturity	6.95%
Labor market block				
			Moments using micro-level evidence	
d	Destruction rate	0.5019	Job destruction rate	0.83%
χ	Vacancy cost	0.6281	Avg vacancy duration	3 wk
			Moments using aggregate-level evidence	
μ_L	Matching efficiency	0.5969	Unemployment rate	6%
s	Separation rate	0.0257	Total job separation rate	3.4%
Credit market block				
			Moments using micro-level evidence	
α_C	Banks' bargaining power	0.8812	Applicants receiving credit within 1 yr	80%
σ	Capital replacement shock	0.0587	Applicants seeking capital replacement	86%
			Moments using aggregate-level evidence	
μ_C	Matching efficiency	0.2887	Bank search duration	4 mo
κ	Banks' search cost	1.0435	Corporate loans/annualized GDP	18.25%
c	Entrepreneurs' search cost	0.2400	Financial sector value added/GDP	2.08%
F	Capital replacement cost	0.8635	Securitized loans/total loans	28.5%

Table 2: Internally Calibrated Parameters and the Corresponding Targeted Moments

This parameterization, together with the following constant elasticity functional form for loan-servicing costs, $\xi(L) = \tilde{\xi}L^{\epsilon}$, leaves us with sixteen parameters to be calibrated internally through the lens of the model. We begin with the most important targets which discipline the importance of the secondary loan market for banks, as well as its effects on the labor market. For the first three targets, we follow the advice of Nakamura and Steinsson (2018) and consider "identified moments." First, we employ the causal estimates of the effect of bank lending frictions on firms' employment and credit availability, estimated in the influential work of Chodorow-Reich (2014). These statistics are "identified" because they are derived from empirical strategies designed to uncover the causal effects of shocks in the syndicated loans market on credit availability and employment. As Nakamura and Steinsson (2018) point out, the advantage of using identified moments is that they provide direct evidence for the causal mechanisms of the model. This is particularly true in our case, since these statistics identify ϵ, the elasticity of loan-servicing costs with respect to the amount of loans the bank keeps on its balance sheet — a key parameter that governs banks' portfolio decisions. Importantly, one of the exogenous shocks considered by Chodorow-Reich (2014) affected the syndicated loans market, making his estimates particularly well-suited for our model. In particular, Chodorow-Reich (2014) uses banks' exposure to the Lehman Brothers bankruptcy through the syndicated market as an instrument for banks' credit supply. Next, he estimates the effects of this shock on the probability of firms receiving loans from the affected banks and on firms' employment growth.[19] We interpret this exercise through the lens of the model as a change in the banks' cost of participation in the credit market, κ. To pin down the size of the shock in the model, we adjust the level of κ such that the model matches the magnitude of Chodorow-Reich's estimate of a 2.32pp drop in the probability of a firm receiving a loan. We then pick ϵ such that the model generates a response equal to the -2.38% change in employment Chodorow-Reich (2014) reports empirically.

Our second target is the causal estimate of the effect of securitization on the price of corporate debt from Nadauld and Weisbach (2012). The authors estimate that otherwise identical loans which were later securitized are issued at an 18 basis points interest discount relative to loans that were never securitized. This statistic, viewed through the lens of our model, identifies the difference in the banks' marginal utility from a securitized loan minus the marginal utility from a non-securitized loan. Thus, this moment informs the value of $\tilde{\xi}$, the scale parameter which governs the size of loan-servicing costs in our model.

Third, we employ the causal estimates in Gupta et al. (2008) who find that liquid loans in the secondary market are issued at an 88 basis point discount relative to illiquid loans. This statistic identifies the bargaining power for dealers, α_D, since it governs how sensitive prices are to changes in the meeting rate λ. More generally, the bargaining parameter governs the sensitivity of the price P to changes in the fundamentals of the OTC market. Consequently, this statistic disciplines both the steady-state magnitude of P and the size of the transmission mechanism of financial shocks in the OTC market to the real economy. The calibrated value of α_D is 0.9974, which is remarkably close to the 0.97 that Feldhütter (2012) and Hugonnier

[19] Our analysis is in steady state, hence we transform the estimates for employment growth in terms of employment levels.

et al. (2020) estimate for the corporate and municipal bonds markets, respectively.

The remaining three moments which pin down parameters in the OTC market also utilize micro-level data from the secondary loan market. The rate of change of investors' valuations, γ is calibrated to match the average bid-ask spread reported in Saunders et al. (2025). To estimate λ, we set the annual turnover rate to 0.7, consistent with recent reports by the Loan Syndications and Trading Association (LSTA) and the micro-level evidence in Siedlarek and Yankov (2025). This yields $\lambda = 0.0321$, implying that an average maturity loan in our model has an 82% chance of receiving between 1 and 5 quotes during its lifetime. This is remarkably close to the 85% empirical estimate in Beyhaghi and Ehsani (2017).[20] Finally, to the best of our knowledge, there is no available direct data on yield to maturity for loans traded in the secondary loan market. The reason is that the loans pay a floating interest, tied to a stochastic benchmark interest rate plus a spread, which makes future coupon payments uncertain. Consequently, a common practice is to calculate the spread-to-maturity rather than the yield-to-maturity. Thus, we target a spread-to-maturity equal to 6.95% (the average reported in Beyhaghi and Ehsani (2017) for the years 1999-2009), which allows us to identify the upper bound of the support for investor valuations, $\bar{\delta}$.

Our next block of targets concerns the labor market. We employ four empirical moments that are salient features of the U.S. labor market. To begin with, we target a long-run unemployment rate of 6% and a monthly separation rate of 3.4% (Shimer, 2005; Bethune and Rocheteau, 2023). We further decompose the monthly separation rate into voluntary quits and temporary layoffs versus permanent job loses. Specifically, in our model separations between workers and firms could occur if the worker "quits" (at rate s) or if the firm fails to secure funding to replace its capital in time (at rate d). We interpret the latter event as a permanent job loss and set the unconditional annual exit rate due to capital obsolesence of all firms to be 10% (Gabrovski and Silva, 2025). The job-filling rate is set to 80% to be consistent with a three week vacancy duration (Blanchard and Summers, 1986; Davis et al., 2013; Gabrovski and Silva, 2025). These four numbers pin down the efficiency of the matching function μ_L, the vacancy search costs χ, the destruction rate d, and the separation rate s.

Turning to the credit block of our model, we pin down μ_C using information on the average search duration in the credit market for banks (four months, based on Petrosky-Nadeau and Wasmer 2013). To calibrate the bargaining power in the credit market, α_C, we

[20]The calculation assumes an average loan duration of 55 months, which is the average observed for loans issued in the early 2000s (Gupta et al., 2008), the sample period in Beyhaghi and Ehsani (2017).

use information on loan approvals from the Small Business Credit Survey (SBCS) conducted by several regional branches of the Federal Reserve System. Specifically, we pooled together the 2015-2019 waves of the survey and computed the average percentage of applicants whose borrowing needs were at least partially satisfied with credit *within the last year*. The average fraction is 80%, which implies $p(\phi) = 1/3$. Next, the SBCS reports that 14% of firms that applied for credit did so to finance repairs or replace their capital. We use this as a target for $1 - \pi$ (that is, the fraction of incumbent firms in the credit market), which allows us to pin down σ. We pin down the search costs in the credit market κ and c by targeting the volume outstanding of corporate loans and the value added of the banking sector as fractions of GDP. The unconditional average of total corporate loans over annualized GDP for the U.S. economy since 1980, using the data series Nonfinancial Corporate Business; Loans; Liability, Level from the Federal Reserve's Board of Governors, is 18.25%. To estimate the value added of the banking sector, we follow the procedure in Petrosky-Nadeau and Wasmer (2013). This yields 2.08% of GDP.[21] To calibrate F, we target the fraction of corporate loans that are securitized and traded in the secondary market. The size of the syndicated loans market for 2024 is estimated to be about 1.5 trillion dollars, which is about 28.5% of total corporate debt. Thus, we use 28.5% as a target for the total fraction of loans that banks supply to the secondary market in the model.

The values of our internally calibrated parameters along with their corresponding targets are collected in Table 2. In Appendix C, we outline the model expressions for each of the sixteen data moments. The tractability of the model allows us to match all empirical targets exactly. This excellent match makes the model a reliable laboratory for quantitative explorations.

5 Quantitative Exercises

In this section, we study the quantitative implications of the model. Our first goal is to understand the role of the secondary loan market and loan-servicing costs for the real economy. To do so, we consider four alternative model economies in which these features are either absent or operate differently than in the benchmark model. We compute the values of the endogenous variables in the alternative model steady states and compare them with

[21] In their sample from 1985 to 2002, Petrosky-Nadeau and Wasmer (2013) find that the share has increased from 1.73% at the start of the sample to 3.5% at the end. For our sample between 2005 and 2025, we do not find such a trend. The value is stable, oscillating between 2% and 3% except for the period during and immediately after the Great Financial Crisis, when the share was lower.

the benchmark economy in Section 5.1. Our second goal is to understand how the existence of a secondary market and loan-servicing costs affects the magnitude of business cycle fluctuations. To this end, we investigate the model's response in different comparative statics exercises. We consider changes in the values of exogenous parameters and report the effects on endogenous variables in the four model economies mentioned above. We study three comparative statics exercises: i) changes in match output, y, in Section 5.2.1, ii) changes in banks' cost of participation on the credit market, κ, in Section 5.2.2, and iii) changes in investor valuations, δ, in Section 5.2.3.

5.1 Steady-State Levels

We begin by computing the steady-state values of several endogenous variables for various model specifications holding all parameters fixed at the calibrated levels of Tables 1 and 2. In order to evaluate the importance of the novel elements of the benchmark model, namely loan-servicing costs and a secondary loan market, we consider three additional models: i) a model without search frictions in the secondary market, ii) a model without a secondary market, in which banks cannot readjust their balance sheets, and iii) a model with neither a secondary market nor loan-servicing costs.[22] Comparing the levels of endogenous variables between the steady states of the various models quantifies the role of loan-servicing costs and the secondary loan market for the real economy. It also highlights the limitations of the partial equilibrium approach we followed in Section 2.3 to study the response of the tightness to changes in the match output. The results are collected in Table 3.

Model / Endogenous Variables	P	Ξ	ϕ	θ	s	u	$\varepsilon_{\theta,y}$	
							Numerical	Partial Eq.
Benchmark	21.15	0.17	0.75	0.67	3.4%	6%	23.09	6.32
With frictionless secondary market	30.67	0.04	0.62	1.89	3.37%	4.51%	15.79	7.19
W/out secondary market	0	0.23	0.76	0.58	3.4%	6.21%	20.69	5.92
W/out secondary market and loan-servicing costs	0	0	0.57	2.54	3.36%	4.15%	16.62	7.81

Table 3: Steady-state Levels of Endogenous Variables in Different Models

In the benchmark model, the price of securitized loans in the secondary market is $P = 21.15$ and removing search frictions raises it to 30.67. Removing search frictions from the

[22] This is the model of Wasmer and Weil (2004) with the addition of capital expenditure financing for firms and the associated capital depreciation shocks.

secondary market allows the asset to reach high-value investors instantaneously, increasing the value of the asset, and allows banks to securitize more loans, saving on loan-servicing costs. The almost 50% increase in the asset price implies that the search frictions plaguing the secondary market have important effects for asset prices, which translate into large real effects: the economy with a frictionless secondary market features significantly more credit, larger job creation, and lower unemployment than the benchmark model. Shutting down the secondary market has the exact opposite effect operating through the same channels: it lowers the return to loan securitization to zero and forces banks to keep all loans in their balance sheets. In turn, this increases the banks' average loan-servicing costs per unit of repayment over the lifetime of the loan, $\Xi \equiv [\pi\xi(\tau_V L_V) + (1-\pi)\xi(\tau_E L_E)]/(r+m_C)$, since now banks have to take care of almost four times as many loans as before (28.5% of loans are securitized in the equilibrium of the benchmark model). The resulting outcomes are qualitatively aligned with those predicted by the parsimonious partial equilibrium model. The zero return to securitization together with the larger loan-servicing costs lowers the surplus in the credit market and fewer entrepreneurs and banks seek a credit partnership. Banks respond more, however, since they are directly affected by the secondary market, and the ratio of entrepreneurs to banks, ϕ, increases. Having fewer banks per entrepreneur implies less credit available for vacancy creation, which lowers the labor market tightness, θ, and increases the total separation rate.[23] As a result, the unemployment rate, u, is higher in the model without a secondary market. The last counterfactual experiment quantifies the importance of the loan-servicing costs and shows that they are substantial: removing them from the model without a secondary market has large effects on real variables. Shutting down the loan-servicing costs raises the credit market surplus which, in turn, generates more credit and job creation, resulting in fewer separations and lower unemployment.

To sum up, the quantitative impact of loan-servicing costs on unemployment is substantial: 6.21 - 4.15 = 2.06pp. At the benchmark calibration, the secondary loan market helps alleviate some of this impact, reducing it to 1.85pp (= 6 - 4.15). Yet, most of it remains, due to the presence of frictions in that market. Eliminating frictions from the secondary market would have a profound impact on unemployment, reducing it by 1.49pp relative to the frictional case. Put differently, a frictionless secondary loan market can eliminate 90% of the drag on unemployment due to loan-servicing costs.

The last two columns of Table 3 report the volatility of the market tightness in each of the

[23]We use the term "total separation rate" to refer to the numerator of the Beveridge curve; see the Beveridge curve equation (54) in Appendix B: total separation rate $\equiv s + dm_C\sigma/[(s+\sigma+m_C)(d+s+p(\phi))+m_C\sigma]$.

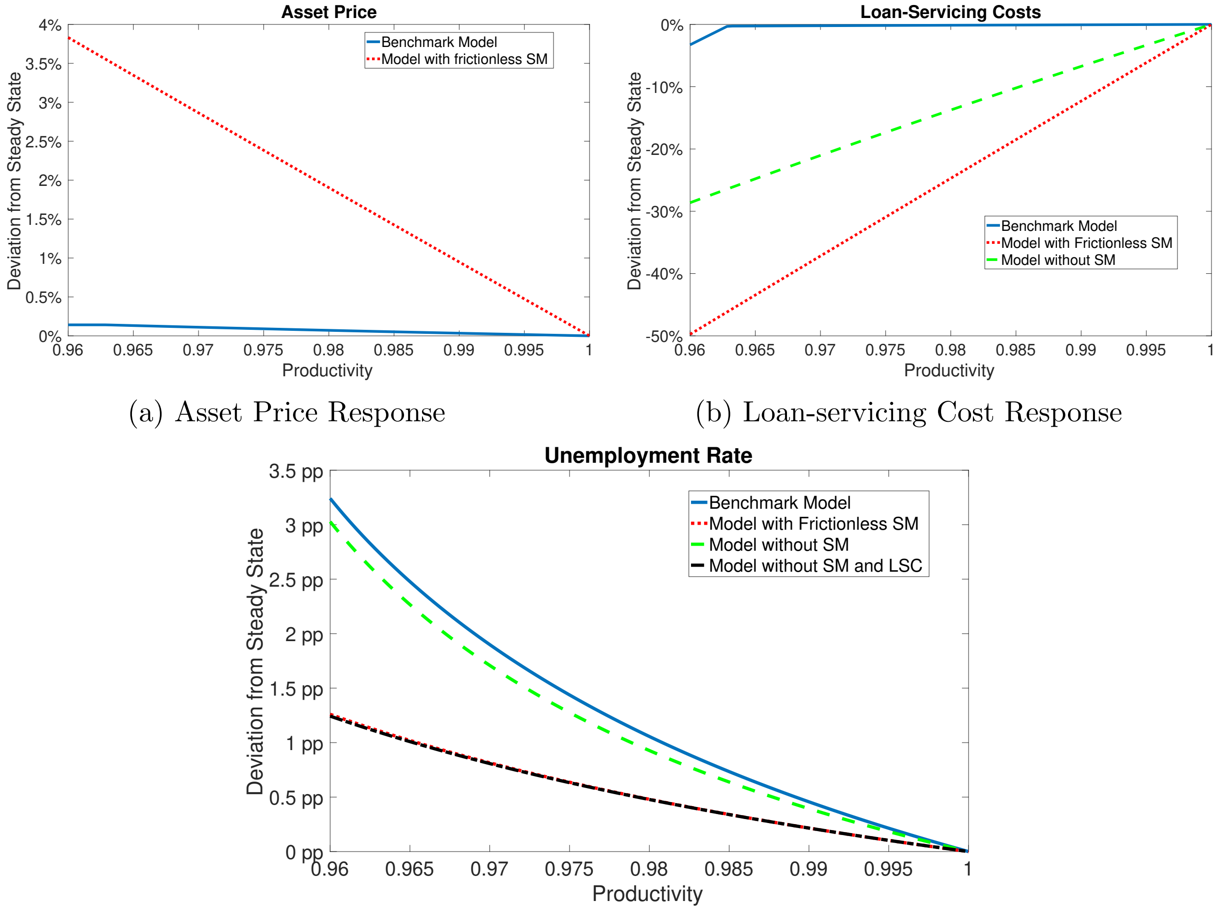
four economies around their steady-state. We compute the elasticities both numerically and analytically, using the partial equilibrium formulas from Section 2. Notably, the computed numerical elasticity in our benchmark model is about one and a half times that in the model without a secondary loan market and loan-servicing costs. The result is in contrast to our partial equilibrium predictions from Section 2. This implies that incorporating general equilibrium effects in the analysis is of first-order importance, as evidenced by the large differences in the market tightness in the two models. Consequently, we devote the rest of this section in numerically exploring the equilibrium implications of loan securitization and loan-servicing costs. Since the economies considered thus far have different benchmark steady states, in what follows we express the endogenous variables as percentage deviations from their original steady-state levels.

5.2 Comparative Statics

In this section we study how the presence of loan-servicing costs and a secondary loan market affect the magnitude of business cycle fluctuations in the economy. To this end we study the response of both real and financial variables to changes in: i) match output; ii) banks' cost of participation in the credit market; and iii) investor valuations. Each of these can be thought of as a potential source of cyclical fluctuations in the macroeconomy. We should stress that our analysis investigates the economy's response at steady state. In this regard we follow Shimer (2005), who shows that in frictional labor market models business cycle fluctuations are well approximated by the steady-state elasticities.

5.2.1 Changes in Match Output

Figure 3 plots the effects of comparative statics with respect to match output in the four alternative models. The endogenous variables of interest are the price of securitized loans (Figure 3a), the total loan-servicing costs (Figure 3b), and the unemployment rate (Figure 3c). The first thing to notice is that lower values of match output generate an increase in the price of securitized loans P. This is due to the lower asset supply: as the real value of entrepreneurial projects drops, banks provide less credit, and, in turn, the supply of loans in the secondary market is lower. As a result, and given that asset demand remains constant, the equilibrium price of securitized loans increases (Figure 3a). Importantly, the asset price increase is an order of magnitude larger in the model with a frictionless asset market than in the benchmark model: prices respond more in a better functioning market than in a market



(a) Asset Price Response

(b) Loan-servicing Cost Response

(c) Unemployment Rate Response

Figure 3: The Effects of Changes in Match Output y.

Figure 3 shows the changes in the asset price P (a), loan-servicing costs (b), and unemployment (c) following a decrease in the match output y. Panels (a) and (b) show deviations from steady-state in percentage terms, whereas panel (c) depicts percentage point changes. The solid blue line depicts our benchmark economy; the dashed green line, a hypothetical economy without a secondary loan market (Model without SM); the dotted red line, an economy with a frictionless secondary market (Model with Frictionless SM); and the dashed black line a model without a secondary market and without loan-servicing costs. The model without SM is derived from the benchmark economy by imposing $\tau = 1$, the model with a frictionless SM is derived by setting $\lambda = 10^6$ in the benchmark model, and the model without SM and LSC is derived from the benchmark economy by setting $\bar{\xi} = 0$.

where search frictions constrain price movements.

The other connection between real and financial variables operates through the total discounted loan-servicing costs Ξ. Since banks provide less credit when productivity declines, they have fewer loans to monitor, and loan-servicing costs decrease. In the model without a secondary market, banks keep all loans in their balance sheets and loan-servicing costs drop sharply (green dashed line in Figure 3b). In the model with a secondary market, the size of the decline in loan-servicing costs depends on the magnitude of the asset price drop.[24] As we showed in Section 2.2, the total loan-servicing cost is a function of P (equation (10)), since the asset price determines the bank's marginal utility of repayment $v'(R)$. Hence, loan-servicing costs drop more in the model with a frictionless secondary market than in the benchmark model, reflecting the different asset price behavior in the two settings. Interestingly, loan-servicing costs in the economy with a frictionless secondary market fall more sharply than those in the economy without a secondary market, highlighting the importance of asset price responsiveness in a well-functioning OTC market.

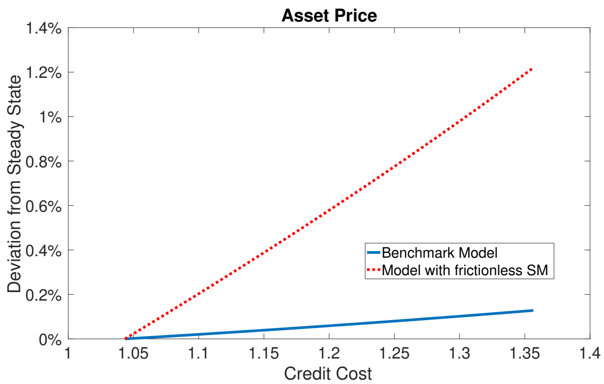
The different magnitudes of the decline in loan-servicing costs are reflected in the response of the unemployment rate to lower levels of match output in Figure 3c. The drop in loan-servicing costs compensates banks for the lower match output and raises the number of banks in equilibrium. Hence, the larger the drop in loan-servicing costs, the smaller the negative impact of the match output on credit and job creation. As a result, the benchmark model features a larger increase in unemployment than both the model with a frictionless secondary market and without a secondary market, since the latter two models feature a sizable drop in loan-servicing costs. These comparisons imply that a frictional secondary loan market amplifies the effects of drops in productivity on unemployment, in line with the mechanisms we highlighted analytically, but provide some additional nuance. Indeed, our quantitative exercises show that the amplification result is not inherently due to secondary loan trading: a secondary market with low-enough frictions could instead have a dampening effect due to a countervailing increase in the asset price in general equilibrium. In fact, this dampening effect due to the asset price can be so large as to completely eliminate the amplifying effect of loan-servicing costs. That is, the magnitude of unemployment fluctuations in the economy with a Walrasian secondary market are about the same as those in a fictional economy without loan-servicing costs.

Lastly, the unemployment response in the model in which both the secondary market and loan-servicing costs are absent is very modest, almost as small as that in the model with a frictionless secondary market. As we explained in the end of Section 2.3, the impact of loan-servicing costs on the volatility of the benchmark model is ambiguous due to the multiple effects they generate. It turns out that the channel working through the credit market tightness ϕ dominates and shutting down loan-servicing costs lowers the unemployment's

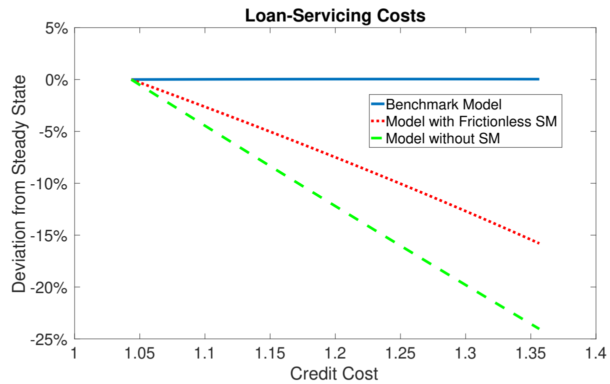
[24] This is true as long as banks are able to re-balance their portfolios. Once τ hits its upper limit of 1, banks keep the entire loan on their books. At this point, the economy switches to an equilibrium in which the secondary loan market shuts down. In Figure 3b, this is evidenced by the kink in the solid blue line representing the benchmark model.

response to productivity drops.

5.2.2 Changes in Credit Cost



(a) Asset Price Response



(b) Loan-servicing Cost Response

(c) Unemployment Rate Response

Figure 4: The Effects of Changes in Credit Cost κ.

Figure 4 shows the changes in the asset price P (a), loan-servicing costs (b), and unemployment (c) following an increase in credit cost κ. Panels (a) and (b) show deviations from steady-state in percentage terms, whereas panel (c) depicts percentage point changes. The solid blue line depicts our benchmark economy; the dashed green line, a hypothetical economy without a secondary loan market (Model without SM); the dotted red line, an economy with a frictionless secondary market (Model with Frictionless SM); and the dashed black line a model without a secondary market and without loan-servicing costs. The model without SM is derived from the benchmark economy by imposing $\tau = 1$, the model with a frictionless SM is derived by setting $\lambda = 10^6$ in the benchmark model, and the model without SM and LSC is derived from the benchmark economy by setting $\bar{\xi} = 0$.

In Figure 4, we present the results for fluctuations that originate in the credit market. We model an exogenous change in the supply of credit as an increase in κ, the banks' cost for credit market participation. Based on our discussion in Section 4, we think of κ as a measure of the banks' balance sheet or screening costs required to initiate a new credit relationship with an entrepreneur or a firm. A higher κ makes lending more costly and, as a result, banks give and securitize less loans, leading to an increase in the secondary market price (Figure 4a). The response of the asset price again depends on the existence of frictions in the secondary market, with the frictionless version delivering much larger responses than the benchmark model with search frictions. Given the lower amount of credit, banks have to take care of less loans and loan-servicing costs decrease in the same way as before (Figure 4b). That is, in the model without a secondary market banks keep all loans in their books and the drop in loan-servicing costs is sizeable. In the model with a secondary market, the drop in asset price regulates the loan-servicing costs decline and the frictionless model delivers a much larger drop than the benchmark model.

Turning to the real side of the economy, Figure 4c illustrates the unemployment rate increases due to the rise in credit cost. The behavior of all models is similar to the case of productivity changes with an interesting twist: even though the drop of loan-servicing costs is larger in the model without a secondary market, the model with a frictionless secondary market delivers a smaller increase in unemployment. The reason is twofold. First, the shock under study here is a change in banks' search costs κ which affects banks disproportionately more than entrepreneurs. In contrast, a productivity shock y reduces the match surplus which affects both parties symmetrically, as shown in equations (19) and (20). Second, banks in the model with a frictionless secondary market can benefit from the increase in asset prices, while banks in the model without a secondary market cannot. The increase in asset prices partially compensates the banks for the higher cost of credit participation. This compensation, however, depends on the extent of search frictions in the secondary market. As a result, the compensatory effect of asset price increases are limited in the benchmark model which features the largest rise in unemployment among all models.

To connect our results with the literature, consider Petrosky-Nadeau (2013) who also studies changes in banks' participation costs. Petrosky-Nadeau (2013) uses steady-state changes in κ to simulate a "credit crunch" in a variant of the Wasmer and Weil (2004) model and he shows that this model produces large responses of real variables to credit fluctuations. Of the four models we consider here, the closest one to Petrosky-Nadeau (2013) is the model without a secondary market and loan-servicing costs. As Figure 4c shows, this model features the smallest increase in unemployment among the four models. Hence, the economic lesson of our analysis is that the existence of loan-servicing costs and a secondary loan market further increases the sensitivity of real variables to a credit crunch.

5.2.3 Changes in Investor Valuations

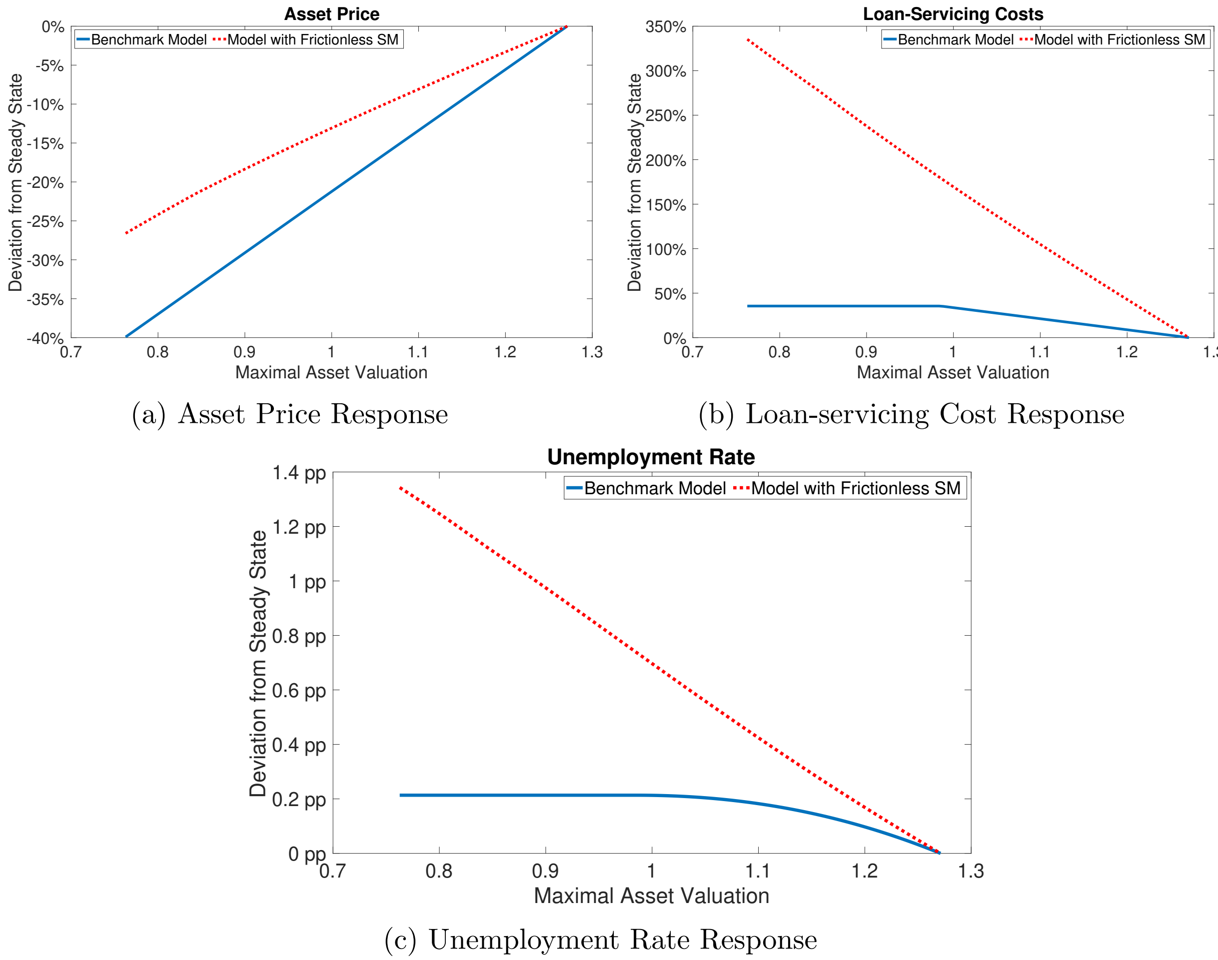


Figure 5: The Effects of Changes in the Maximal Asset Valuation $\bar{\delta}$.

Figure 5 shows the changes in the asset price P (a), loan-servicing costs (b), and unemployment (c) following a decrease in the maximal asset valuation $\bar{\delta}$. Panels (a) and (b) show deviations from steady-state in percentage terms, whereas panel (c) depicts percentage point changes. The solid blue line depicts our benchmark economy and the dotted red line, an economy with a frictionless secondary market (Model with Frictionless SM). The model with a frictionless SM is derived by setting $\lambda = 10^6$ in the benchmark economy.

In this section, we study the implications of the model for fluctuations that originate in the OTC financial market. Since the focus is on the secondary market, we disregard the models without that feature. Figure 5 illustrates the results for changes in $\bar{\delta}$, the maximal asset valuation. By changing $\bar{\delta}$ while holding $G(\delta)$ to uniform and $\underline{\delta}$ to zero, we manipulate the value of securitized loans for all investors. We choose the lowest value of $\bar{\delta}$ in the experiment to engineer a 40% drop in the asset price, which was the magnitude observed in the secondary market during the financial crisis of 2009 (Irani and Meisenzahl, 2017).

The main result of Figure 5 is that this drop in investors' valuations generates a meaningful increase in the unemployment rate (Figure 5c). As securitized loans become less valuable to investors, their price declines (Figure 5a). The magnitude of the asset drop depends on the existence of frictions: prices drop less without search frictions than in the benchmark model. In turn, these differences are reflected in loan-servicing costs, which increase as loans become less valuable and banks keep more of them in their balance sheet (Figure 5b). The combined effects of lower asset prices and higher loan-servicing costs result in lower credit, less job creation, and higher unemployment. The figure highlights the importance of the rate at which banks leave the secondary market following financial market turmoil. Our benchmark economy starts at a low level of securitization and sees a rapid exit of banks. Consequently, the market quickly shuts down: τ hits its upper bound of 1, at which point banks do not securitize any of the loans. At that point, the real economy is no longer affected by the fundamentals in the secondary market and the response of unemployment to further reduction in investor valuations is flat. Interestingly, when investor valuations change, the model with a frictionless asset market generates larger responses than the benchmark model (Figure 5c). This implies that a better-functioning secondary market would serve to stabilize output fluctuations that stem from either productivity or credit shocks, but would have the opposite effect during crises caused by financial shocks.

6 Conclusion

We develop a microfounded general equilibrium search-theoretic model with a labor, credit, and financial markets to study the mechanisms through which the secondary loan market affects the real economy. The modeling of each frictional market follows an established path from the literature: the labor market is à la Diamond (1982) and Mortensen and Pissarides (1994); the credit market is à la Wasmer and Weil (2004); and the secondary financial market is à la Duffie et al. (2005). Our model departs from the literature in a crucial way: banks suffer loan-servicing costs for each unit of loan they keep on their books. This assumption enables us to capture the central reason motivating banks to securitize loans in practice, and to study the macroeconomic implications of their optimal portfolio decisions.

We show analytically that loan-servicing costs act as an automatic stabilizer. Intuitively, following a decrease in productivity, worker-firm matches are less profitable, which lowers vacancy creation and raises unemployment. At the same time, lower vacancy creation reduces congestion in the labor market, making it cheaper to find a worker. As a result, banks issue less credit, which decreases their loan-servicing costs. This effect serves to partially outweigh the negative impact of lower productivity, thereby mitigating the magnitude of the unemployment response. Introducing a secondary loan market reduces the steady-state level of unemployment, as banks can now securitize some of their loans and save on loan-servicing costs. At the same time, if the asset price in the secondary market is fixed, we show that the presence of the market amplifies the volatility of unemployment. The reason is that banks' loan-servicing costs are now tied to the price of the asset which is stable.

We study the quantitative importance of these mechanisms in the context of a richer model, in which both new and incumbent firms require financing; firms make capital expenditures; and the secondary loan market is modeled in detail. The calibrated economy matches a rich set of identified and non-identified moments based on micro-level evidence, making it a good laboratory for our numerical experiments We estimate a substantial effect of loan-servicing costs on unemployment equal to 2pp. At the same time, our benchmark economy with a frictional secondary loan market can alleviate about 0.2pp of this effect. We show that this modest impact is due to the frictions in the secondary market: a hypothetical Walrasian market for loans can eliminate 90% (or 1.85pp) of the drag on unemployment due to loan-servicing costs. Moreover, banks' choice to securitize loans has a profound impact on the volatility of the real economy as well. We show that, following a reduction in labor productivity (or an increase in credit supply costs for banks), the benchmark economy with a frictional secondary market sees a significantly higher increase in unemployment than a hypothetical economy in which banks cannot securitize loans, lending credence to our analytical exercise, which kept prices fixed. Frictions have important implications for volatility as well — the hypothetical economy with a Walrasian loan market is almost half as volatile as the benchmark economy. Intuitively, this is the case because in a Walrasian market the price responds more strongly to changes in fundamentals. Because of this same intuition, the economy with a Walrasian market features significantly higher volatility following financial turmoil.

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A Proof that $\theta^{NS} \leq \theta \leq \theta^{WW}$

Proof. First, recall that when $v'(R) = 1$ the model economy converges to that in WW, so $\theta = \theta^{WW}$. Next, consider $v'(R) < 1$. Thus, $\phi > \phi^{WW}$, which implies that $c/p(\phi) > c/p(\phi^{WW})$. Hence,

$$\frac{q(\theta)}{r+q(\theta)}\left[\frac{y-w}{r+s} - \frac{1}{v'(R)}\frac{\chi}{q(\theta)}\right] > \frac{q(\theta^{WW})}{r+q(\theta)^{WW}}\left[\frac{y-w}{r+s} - \frac{\chi}{q(\theta)^{WW}}\right],$$
$$\frac{q(\theta)}{r+q(\theta)}\left[\frac{y-w}{r+s} - \frac{\chi}{q(\theta)}\right] > \frac{q(\theta^{WW})}{r+q(\theta)^{WW}}\left[\frac{y-w}{r+s} - \frac{\chi}{q(\theta)^{WW}}\right],$$
$$\frac{q(\theta)}{r+q(\theta)}\frac{y-w}{r+s} - \frac{\chi}{r+q(\theta)} > \frac{q(\theta^{WW})}{r+q(\theta)^{WW}}\frac{y-w}{r+s} - \frac{\chi}{r+q(\theta)^{WW}},$$
$$\theta < \theta^{WW},$$

where the first inequality follows from $v'(R) < 1$ and the last follows from $q(z)/[r + q(z)]$ and $-1/[r + q(z)]$ both being strictly decreasing functions of z.

Analogously, one can show that the market tightness in the NS economy is such that $\theta^{NS} \leq \theta$, with equality only when banks choose to keep the entirety of the loans on their books. ■

B Full model equilibrium

In this section, we detail the equilibrium of the extended model that we introduced in Section 3. We begin by closing the description of the model environment through since the main text does not specify the bargaining environment and the laws of motion.

Bargaining. The bargaining problem faced by the bank and a new entrant and the one faced by the bank and the existing firm are given by:

$$R_V = \arg\max_R \left[B_V - B_C\right]^{\alpha_C} \left[E_V - E_C\right]^{1-\alpha_C}, \tag{38}$$

$$R_E = \arg\max_R \left[\max_{\tau_E \in [0,1]} \{B_J(\tau_E) + P(1-\tau_E)R\} - F - B_C\right]^{\alpha_C} \left[E_J(R) - E_J^F\right]^{1-\alpha_C}. \tag{39}$$

Laws of motion. The life of a project in our calibrated economy takes a more involved form as compared to the simplified economy in Section 2. Figure 6 depicts the different stages a project may find itself in.

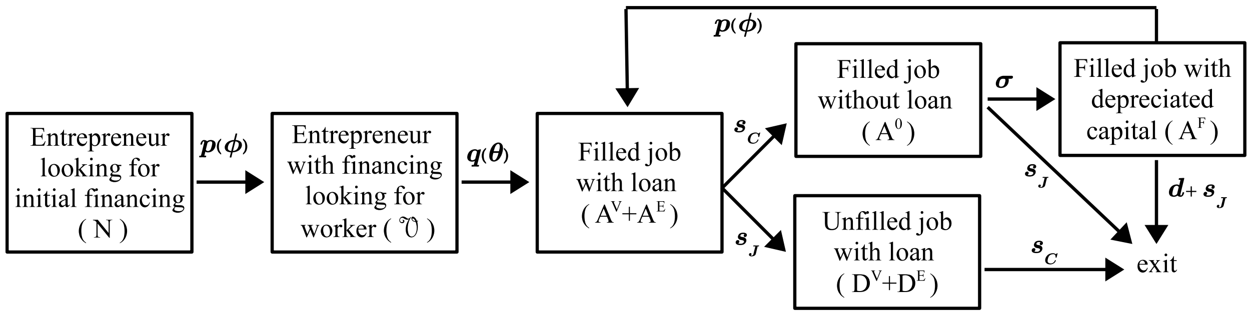

Figure 6: Life of a project.

The figure details the life of a project. New projects (N) begin their life as entrepreneurs looking for financing. At rate $p(\phi)$ they obtain a loan and transition to labor market vacancies ($\mathcal{V}$). At rate $q(\theta)$ the vacancy is filled and transition to a filled job with a vacancy loan (A^V). The firm and worker separate at rate s, resulting in a "dead" firm with a vacancy loan $v'(R_V)$. Once the loan matures, the firm exits. Alternatively, if the firm's loan matures before it separated with a worker, the firm transitions to a filled job without a loan (A^0). This firm is subject to depreciation shocks: at rate σ it transitions to a firm looking for financing (A^F). If the firm manages to find financing before its worker separates or before its capital becomes completely inoperable, it transitions to a firm with an incumbent loan (A^E).

The laws of motion for projects in different states are straightforward to describe. Let A^V denote filled jobs which are repaying their initial loan; A^F filled jobs looking for financing, i.e. with depreciated capital; A^E filled jobs which are repaying an incumbent loan; D^V firms that have separated from the worker but are still repaying their initial loan, and D^E those repaying an incumbent loan. Let N denote the number of new projects looking for financing and $\mathcal{V}$ the number of vacancies. Then, the laws of motion are given by:

$$\dot{\mathcal{V}} = p(\phi)N - q(\theta)\mathcal{V}, \tag{40}$$

$$\dot{A}^V = q(\theta)\mathcal{V} - (s + m_C)A^V, \tag{41}$$

$$\dot{A}^0 = m_C(A^V + A^E) - (\sigma + s)A^0, \tag{42}$$

$$\dot{A}^F = \sigma A^0 - (s + d + p(\phi))A^F, \tag{43}$$

$$\dot{A}^E = p(\phi)A^F - (m_C + s)A^E, \tag{44}$$

$$\dot{D}^E = sA^E - m_C D^E, \tag{45}$$

$$\dot{D}^V = sA^V - m_C D^V. \tag{46}$$

The laws of motion for the masses of projects in any given state of their life equate the flows in and out of any given state. For example, looking at (43), the mass of filled jobs looking for financing increases by σ, the rate at which capital depreciates, times the mass of producing jobs without a loan, A^0. It decreases by an amount corresponding to all those firms that have found financing $p(\phi)A^F$ plus all those firms who have exited the market due to separation with a worker, sA^F, or due to their capital becoming unproductive, dA^F. The other laws of motion are interpreted analogously, so we omit their interpretation for succinctness.

The law of motion for unemployment takes the familiar form:

$$\dot{\mathcal{U}} = s(A^V + A^0 + A^F + A^E) + dA^F - \theta q(\theta)\mathcal{U}. \tag{47}$$

The flow into unemployment is given by all those workers who are employed by a firm, regardless of whether or not the firm has a loan, times the separation rate, s, plus all those workers employed at firms that need financing times the rate with which depreciated capital becomes completely inoperable. The flow out of unemployment is simply the number of unemployed workers times the job-finding rate, $\theta q(\theta)$.

The real economy. It is straightforward to show that the optimal τ_V^* is still implicitly given by (9) (with s replaced by m_C). Analogously, we can derive an expression for τ_E^* and show that the it satisfies $\tau_E^* = \tau_V^* L_V/L_E$. Intuitively, the bank wishes to hold the same amount of assets on its book regardless of the nature of the borrower, so $\tau_E^* L_E = \tau_V^* L_V$. Depending on parameter values, it could be the case that $L_E < \tau_V^* L_V$, i.e. the negotiated repayment for an incumbent firm is less than the optimal amount of assets the bank will hold on its books. In that case the optimal τ_E^* is 1 and $\tau_E^* L_E < \tau_V^* L_V$. However, we do not detail this case in the exposition as it is not relevant given the calibrated model parameters.[25] Solving for the repayments, R_V and R_E yields the expressions:

$$\frac{R_V}{r + m_C} = \alpha_C \Psi + \frac{1 - \alpha_C}{D_V} \left[\frac{\chi}{q(\theta)} + F \right], \tag{48}$$

$$\frac{R_E}{r + m_C} = \alpha_C \left(\Psi - E_J^F \right) + \frac{(1 - \alpha_C)}{D_E} F, \tag{49}$$

where $D_i \equiv \tau_i^*[1 - \xi(\tau_i^* L_i)] + (1 - \tau_i^*)P(r + m_C)$ is the average marginal flow utility the bank receives per unit of repayment R_i $(i = V, E)$ and $\Psi \equiv (y - w - m_C E_J^0)/(r + m_C + s)$ is the firm's expected revenue net of wages and future capital expenditures. Compared to (16), the expression for R_V is very similar — there are only two differences: the firm's revenue now takes into account that the loan may mature before the firm-worker pair separates; the vacancy loan includes the capital expenditures F. The expression for R_E is analogous but with two main differences from that for R_V. First, the outside option for an incumbent firm

[25] In particular, given our calibration, F is large enough so that banks always want to securitize at least a portion of the loan.

is to continue searching for financing, so the maximal payoff the bank can extract is $\Psi - E_J^F$. Second, the firm already has a worker so the loan principal is only F.

Next, plugging the solutions for R_V and R_E into the forward looking expressions for E_V and B_V and using the free entry conditions yields

$$\text{EE'}: \quad \frac{c}{p(\phi)} = (1-\alpha_C)\frac{q(\theta)}{r+q(\theta)}\left[\Psi - \frac{1}{D_V}\left(\frac{\chi}{q(\theta)} + F\right)\right], \tag{50}$$

$$\text{BB'}: \quad \frac{\kappa}{\phi p(\phi)} = (1-\pi)D_V\alpha_C\frac{q(\theta)}{r+q(\theta)}\left[\Psi - \frac{1}{D_V}\left(\frac{\chi}{q(\theta)} + F\right)\right] + \pi D_E \alpha_C\left[\left(\Psi - E_J^F\right) - \frac{F}{D_E}\right], \tag{51}$$

where $E_J^F = [y - w + p(\phi)(\Psi - R_V/(r+m_C))]/[r+s+d+p(\phi)]$, as implied by the Bellman equations (24) and (27). Comparing the above two equations to the EE and BB loci in the benchmark economy, we see that the EE' locus has the same functional form, but the BB' locus as an extra term corresponding to the possibility a banker will meet an incumbent firm on the credit market. This affects the bank's expected profit through three distinct channels. First, the benefit to the bank from extending a loan to an incumbent firm is relatively lower because that firm has a better outside option — E_J^F vs 0 for a new entrant. This tends to lower the bank's expected profit from participating in the credit market. Second, the loan size is smaller when the bank extends credit to an incumbent firm. This effect works in the opposite direction and tends to increase expected profits. Third, besides the difference in the outside option of the firm and the loan size, there is a timing difference associated with extending credit to incumbent firms as opposed to new entrants. When a bank extends credit to an incumbent firm, the capital is purchased instantaneously and the firm begins repayment immediately. This is in contrast to extending credit to a new entrant who begins repaying only after she finds a worker. This effect tends to make lending to incumbent firms relatively more profitable.

Next, because of the possibility of capital depreciation, the firm's expected revenue net of wages, Ψ, is now lower than in the benchmark economy. Intuitively, this is the case because (i) the possibility of capital depreciation reduces the expected duration of the match and (ii) the need to secure future financing allows the bank to extra some of the match surplus. Mathematically, using the Bellman equations for the firm, (24), (25), (26), (27) one can show that

$$\Psi = \frac{a(\phi)}{[1-a(\phi)]p(\phi)}(y-w)\left[1+\frac{r+s+d+p(\phi)}{\sigma}\left(1+\frac{r+s+\sigma}{m_C}\right)\right]$$

$$-\frac{a(\phi)}{1-a(\phi)}\left[\alpha_C\Psi+\frac{1-\alpha_C}{D_V}\left[\frac{\chi}{q(\theta)}+F\right]\right], \tag{52}$$

where $a(\phi) \equiv m_C\sigma p(\phi)/[(r+s+m_C)(r+s+\sigma)(r+s+d+p(\phi)]$.

Lastly, the probability a bank will meet an incumbent firm on the credit market, π, is an endogenous variable that depends on the relative sizes of new entrants to incumbents looking for financing. In particular, $\pi \equiv A^F/(N+A^F)$. Manipulating the laws of motion, (40) - (46) yields

$$\pi = \frac{m_C}{m_C+s}\frac{\sigma}{s+\sigma}\frac{p(\phi)}{d+s+p(\phi)}. \tag{53}$$

This gives rise to a composition effect — as the ratio of credit seekers to banks, ϕ, increases, the credit-finding rate $p(\phi)$ goes down, and so does π. Hence, there are relatively fewer incumbent firms looking for financing. Since ϕ and θ co-move along the BB' locus, when θ is high the bank finds it relatively more profitable to lend to incumbent firms, but there is very few of them on the market which serves to lower the bank's expected payoff. This composition effect tends to rotate the BB' locus up.

Apart from its effect on the equilibrium tightnesses, the incumbent firm financing channel affects unemployment directly because separations are endogenous in this setting. In particular, once a firm's capital depreciates the chance that it finds financing before its capital becomes unproductive is $p(\phi)/[d+p(\phi)]$. This probability is endogenous and depends on the level of congestion in the credit market: if firms find it hard to secure financing, then it is less likely they will find the funds in time, which results in a higher aggregate separation rate. To see this clearly, focus on the steady-state unemployment level. Applying straightforward algebra to (41) - (47) leads to the following expression

$$\mathcal{U} = \frac{s+\frac{dm_C\sigma}{(s+\sigma+m_C)(d+s+p(\phi))+m_C\sigma}}{\theta q(\theta)+s+\frac{dm_C\sigma}{(s+\sigma+m_C)(d+s+p(\phi))+m_C\sigma}}. \tag{54}$$

The endogenous component of separations is then $\frac{dm_C\sigma}{(s+\sigma+m_C)(d+s+p(\phi))+m_C\sigma}$, which is strictly decreasing in the loan-finding rate, as expected.

Together (48), (49), (50), (51), (52), (53), and (54), along with the optimal τ_V^* and τ_E^* solve for ϕ, θ, Ψ, π, u R_E, R_V as a function of the inter-dealer price for assets P.

The secondary loan market and the asset price. Next, we characterize the equilibrium in the secondary loan market. To begin with, we focus on the price of the asset in the inter-dealer market, P. First, plugging the solution for the bid and ask prices, $B(\delta) = A(\delta) = \alpha_D \Delta V(\delta) + (1-\alpha_D)P$, into the Bellman equations for the investor when she does and does not have the asset, (31) and (32), and combining the two yields an expression for the investor's reservation value

$$(r + m_C)\Delta V(\delta) = \delta + \gamma \int [\Delta V(\delta') - \Delta V(\delta)]\mathrm{d}\delta' + \lambda(1-\alpha_D)\max\{P - \Delta V(\delta), 0\} \\ - \lambda(1-\alpha_D)\max\{\Delta V(\delta) - P, 0\}. \quad (55)$$

This expression has a standard interpretation: the left-hand side of the equation is the annualized reservation value. The first term on the right-hand side is the utility flow of holding the asset, the second term is the flow of expected net utility from a type change, the third term captures the net utility flow of selling the asset, and the last term is the negative of the utility flow from purchasing the asset. Using that $\max\{P - \Delta V(\delta), 0\} - \max\{\Delta V(\delta) - P, 0\} = P - \Delta V(\delta)$, one can express the reservation value of the investor by

$$(r + m_C)\Delta V(\delta) = \delta + \gamma \int [\Delta V(\delta') - \Delta V(\delta)]\mathrm{d}\delta' + \lambda(1-\alpha_D)[P - \Delta V(\delta)]. \quad (56)$$

Taking the expectations of both sides of the above expression and substituting it back yields an explicit solution for the reservation value:

$$\Delta V(\delta) = \frac{r+m_C}{r+m_C+\lambda(1-\alpha_D)}\left[\frac{r+m_C+\lambda(1-\alpha_D)}{r+m_C+\gamma+\lambda(1-\alpha_D)}\frac{\delta}{r+m_C} \right. \\ \left. + \frac{\gamma}{r+m_C+\gamma+\lambda(1-\alpha_D)}\int \frac{\delta'}{r+m_C} g(\delta')\mathrm{d}\delta'\right] + \frac{\lambda(1-\alpha_D)}{r+m_C+\lambda(1-\alpha_D)}P. \quad (57)$$

Conditional on contacting a dealer, investors find it optimal to hold the asset if and only if $\delta > \delta^*$. Thus, $P = \Delta V(\delta^*)$. Hence, the price satisfies

$$P = \frac{1}{r+m_C}\left[\frac{r+m_C+\lambda(1-\alpha_D)}{r+m_C+\gamma+\lambda(1-\alpha_D)}\delta^* + \frac{\gamma}{r+m_C+\gamma+\lambda(1-\alpha_D)}\mathbb{E}(\delta)\right]. \quad (58)$$

At first glance, it may seem like the price does not depend on the real side of the economy.

Upon further inspection, however, it becomes evident that the real economy affects the inter-dealer price through the supply of the asset, which ultimately determines the reservation investor type δ^*. In particular, all of the asset must be held by some investors, so $\mathcal{A} = \int \psi_1(\delta)\mathrm{d}\delta$. Using the steady-state expression for $\psi_1(\delta)$ from (35) yields

$$\mathcal{A} = \frac{\lambda}{\lambda + m_C}[1 - G(\delta^*)], \tag{59}$$

implicitly characterizing the marginal investor valuation δ^* as a function of the asset supply $\mathcal{A}$. The two objects are inversely related: for the market to clear, an increase in the asset supply must be accompanied by a decrease in the mass of investors willing to purchase the asset, which implies a decrease in the valuation of the marginal investor. Therefore, using (58), we can observe that an increase in asset supply goes hand-in-hand with a decrease in the asset price, as would be expected. Note that the marginal investor type is such that in the absence of frictions ($\lambda \to \infty$) there is just enough investors who are willing to hold the asset as there are units of the asset.

In equilibrium the asset supply is determined by the real side of the economy. Specifically, at any point in time there are $A^V + D^V$ firms with a vacancy loan. Each of these loans has been securitized into R_V units of the asset at the time of origination, and a fraction $1 - \tau_V^*$ of these units were sold by the bank on the inter-dealer market. Similarly, there are $A^E + D^E$ incumbents with a loan, each securitized into R_E units of the asset. Since banks only sell a fraction $1 - \tau_E^*$ of these assets to the secondary market upon origination, it follows that asset supply is

$$\mathcal{A} = (1 - \tau_V^*)R_V(A^V + D^V) + (1 - \tau_E^*)R_E(A^E + D^E). \tag{60}$$

Together (58), (59), and (60) solve for the price, P, reservation value, δ^*, and asset supply, $\mathcal{A}$, as a function of the real variables τ_E^*, τ_V^*, R_E, and R_V.

C Model Expressions for Empirical Targets

In this section we derive the model expressions of the data targets for the calibration in Section 4. A detailed description of the targets and their sources is included in the main text, so here we focus on mapping the targets to model expressions. We begin with the labor market block, as it is most standard.

First, the target for unemployment is simply $\mathcal{U}$. Next, the job separation rate in our economy is endogenous and given by

$$\text{total job separations} = s + \frac{dm_C\sigma}{(s+\sigma+m_C)(d+s+p(\phi))+m_C\sigma}, \tag{61}$$

as implied by (54). Next, the job-filling rate in our economy is $q(\theta)$. Thus, an average vacancy duration of 3 weeks implies $q(\theta) = 1-(1-1/3)^4$. Our last labor market block moment targets a 10% annual separation due to firms not being able to find financing. The number of existing firms with a worker, looking for financing is A^F and total employment is $1-\mathcal{U}$. Thus, we set

$$\text{job destruction rate} = 0.83\% = \frac{dA^F}{1-\mathcal{U}}. \tag{62}$$

Turning to the credit market block, the bank's search duration is given by $1/[\phi p(\phi)]$. Next, the measure of firms looking for financing at any point in time is $N + A^F$ and the measure of firms which receive credit every month is $p(\phi)(N + A^F)$. Thus, over the course of a year the ratio of successful credit applicants to all applicants is given by:

$$\text{fraction of applicants receiving credit} = 80\% = \frac{12p(\phi)}{1+12p(\phi)}. \tag{63}$$

Next, the fraction of firms who are seeking capital replacement loans is simply the fraction of firms not looking for a vacancy loan, i.e, π. In the model total loans are given by F times the number of firms with any kind of loan, $A^V + D^V + A^E + D^E$, plus $\chi/q(\theta)$ times the number of firms with vacancy loans, $A^V + D^V$. Thus,

$$\frac{\text{Total corporate loans}}{\text{Annualized GDP}} = \frac{F(A^V+D^V+A^E+D^E)+\frac{\chi}{q(\theta)}(A^V+D^V)}{12(1-\mathcal{U})y}. \tag{64}$$

In our economy, the value added in the financial sector is the difference in the monthly bank revenue net of costs:

$$\begin{aligned}\text{bank profits} = {} & (A^E+D^E)[(1-\tau_E^*)(r+m_C)PR_E+(r+m_C)B_J(\tau_E^*L_E)] \\ & +(A^V+D^V)[(1-\tau_V^*)(r+m_C)PR_V+(r+m_C)B_J(\tau_V^*L_V)] \\ & -\chi\mathcal{V}-[q(\theta)\mathcal{V}+p(\phi)A^F]F-\mathcal{B}k,\end{aligned} \tag{65}$$

where the last line expresses the banks' costs as the sum of all vacancy costs, capital expenditure financing, and bank search costs. Our target is thus (bank profits)/$[(1-\mathcal{U})y] = 2.08\%$. The fraction of loans that are securitized is simply the amount of loans banks do not keep on their books divided by all loans issued, i.e.

$$\text{Securitized fraction of loans} = \frac{(1-\tau_E^*)F(A^E + D^E) + (1-\tau_V^*)(F + \frac{\chi}{q(\theta)})(A^V + D^V)}{F(A^V + D^V + A^E + D^E) + \frac{\chi}{q(\theta)}(A^V + D^V)}. \quad (66)$$

Next, we turn to the secondary loan market block. Chodorow-Reich (2014) reports that following a credit crunch employment drops by 2.38%. Through the lens of our model, we can view a credit crunch as an increase in the banks' cost of operating in the credit market, κ. On challenge is that these costs are not observable, so we do not know how large of an increase in κ would correspond to the empirically observed credit crunch in Chodorow-Reich (2014)'s sample. To overcome this issue, we calibrate the size of the shock to 26.44% in order to match a 2.33pp decrease in the probability of receiving a loan in equilibrium: the empirically observed reduction in credit supply reported by Chodorow-Reich (2014). Thus, we solve the model' steady-state equilibrium to generate an initial level of employment $e = 1 - \mathcal{U}$, then raise κ by 26.44%, so that the probability a firm receives a loan decreases by 2.33pp, and then calculate the new level of employment, e'. Next, we scale the level of employment in the model e and e' such that its level is comparable to that in Chodorow-Reich (2014).[26] We then calculate the resulting change in employment following the formula in Chodorow-Reich (2014) for the level of employment growth g:

$$g = \frac{e' - e}{0.5(e' + e)} \times 100. \quad (67)$$

Consequently, the resulting change in the growth of employment is found by differentiating with respect to κ, i.e.

$$\frac{dg}{d\kappa} = 200\frac{(e' + e) - (e' - e)}{(e' + e)^2}\frac{de'}{dk} = \frac{400e}{(e' + e)^2}\frac{de'}{dk}, \quad (68)$$

where we take de'/dk to be the model-generated difference $e' - e$.

Next, Nadauld and Weisbach (2012) report that banks charge 18 bps lower rates for loans traded in the secondary market. In our model there is no interest rate, however, given the

[26] In particular, Chodorow-Reich's sample features 2,400 establishments with a mean employment level of 2,985 individuals. This yields a total number of employed people of 6,089,400. Thus, we re-scale e so that it is equal to 6,089,400 and we re-scale e' so that it is equal to 6,089,400$\times e'/e$.

loan principal and the repayment, the implied interest rate is $i_i = R_i/L_i - m_C$, where the index stands for either E or V depending on the type of the loan. In our model all loans are traded on the secondary market. So, to construct the interest rate for non-traded loans, i_i^N, we calculate the repayment R_i^N the bank and entrepreneur would have negotiated if the bank were forced to keep the entire loan on its books. Equations (48) and (49) imply that the negotiated repayments would have been

$$\frac{R_V^N}{r+m_C} = \alpha_C \Psi + \frac{1-\alpha_C}{1-\xi(L_V)}\left[\frac{\chi}{q(\theta)} + F\right], \tag{69}$$

$$\frac{R_E}{r+m_C} = \alpha_C\left(\Psi - E_J^F\right) + \frac{(1-\alpha_C)}{1-\xi(L_E)}F. \tag{70}$$

Hence, the difference in the two interest rates is

$$i_i^N - i^i = (1-\alpha_C)(r+m_C)\left[\frac{1}{1-\xi(L_i)} - \frac{1}{D_i}\right]. \tag{71}$$

Taking a weighted average of the spread for vacancy and capital replacement loans and annualizing implies

$$\begin{aligned} &\text{Bank discount for securitized loans} = \\ &12\left\{\frac{(F+\frac{\chi}{q(\theta)})(A^V+D^V)}{(F+\frac{\chi}{q(\theta)})(A^V+D^V)+F(A^E+D^E)}(1-\alpha_C)(r+m_C)\left[\frac{1}{1-\xi(L_V)} - \frac{1}{D_V}\right]\right. \\ &\left. + \frac{F(A^E+D^E)}{(F+\frac{\chi}{q(\theta)})(A^V+D^V)+F(A^E+D^E)}(1-\alpha_C)(r+m_C)\left[\frac{1}{1-\xi(L_E)} - \frac{1}{D_E}\right]\right\}. \end{aligned} \tag{72}$$

To pin down the dealers' bargaining power, α_D, we turn to the evidence in Gupta et al. (2008). The authors put forth several measures of liquidity and estimate that liquid loans are issued at an average discount of 88 basis points, relatively to illiquid loans. To match this moment we proceed in the following way. First, the authors report that 13.9% of loans are quoted at least twice on any given day within the first 365 days since their origination. We take these to be the liquid loans in their sample. The authors also report that 12.8% of all loans receive at least 2 quotes on at least 100 trading days during their sample period. Given that a typical loan in their sample is observed for about 32 months and there are about 20.92 trading days on average in a month, this implies the contact rate for liquid loans is $\lambda_H = 15.14$. Next, out of all loans, 85.1% were not quoted at all. Thus, conditional on being illiquid, a loan has 1.16% chance of being quoted on at least one day during the subsequent

22 months it spends in the sample. Thus, $\lambda_L = 0.16$. Having pinned down the two contact rates for the liquid and illiquid loans, we then solve the model under each contact rates and set the difference in the average loan rates $i_i = R_i/L_i - m_C$ to the 88 basis points estimated by Gupta et al. (2008).

We now turn to the bid-ask spread. Recall that the bid and ask prices for a type δ investor are given by the weighted average of the reservation value $\Delta V(\delta)$ and the inter-dealer price P: $B(\delta) = A(\delta) = \alpha_D \Delta V(\delta) + (1-\alpha_D)P$. Since, in equilibrium all types below the reservation are only looking to sell the asset and all types above are only looking to buy it, it follows that the average observed bid and ask prices are

$$\mathbb{E}[B(\delta)] = \int_{\delta_L}^{\delta^*} \alpha_D \Delta V(\delta) + (1-\alpha_D)P \frac{\psi_1(\delta)}{\Psi_1(\delta^*) - \Psi_1(\delta_L)} d\delta, \tag{73}$$

$$\mathbb{E}[A(\delta)] = \int_{\delta^*}^{\delta_H} \alpha_D \Delta V(\delta) + (1-\alpha_D)P \frac{\psi_0(\delta)}{\Psi_0(\delta_H) - \Psi_0(\delta^*)} d\delta. \tag{74}$$

Thus, the model-equivalent expression for the bid/ask spread is given by

$$\text{Bid/ask spread} = \frac{\mathbb{E}[A(\delta)] - \mathbb{E}[B(\delta)]}{(\mathbb{E}[A(\delta)] + \mathbb{E}[B(\delta)])/2} \times 100. \tag{75}$$

Turnover in the secondary market is the ratio of trade volume to market capitalization. The trade volume is simply the average observed price $\tilde{P}$ times the contact rate λ times the mass of agents that would trade the asset if given the opportunity to contact a dealer. Since this mass is comprised of all non-owners of type above δ^* and all owners of type below δ^*, it follows that

$$\text{trade volume} = \left[\int_{\delta_L}^{\delta^*} \psi_1(\delta)\delta + \int_{\delta^*}^{\delta_H} \psi_0(\delta)\delta\right] \tilde{P}. \tag{76}$$

As market capitalization is the product of the average price $\tilde{P}$, times the asset supply, it follows that

$$\text{turnover} = \frac{\left[\int_{\delta_L}^{\delta^*} \psi_1(\delta)\delta + \int_{\delta^*}^{\delta_H} \psi_0(\delta)\delta\right]}{\mathcal{A}}. \tag{77}$$

Lastly, we turn to the spread-to-maturity. Our asset yield a coupon payment of 1 every instant and the price at which they are purchased by investors is $A(\delta)$. Thus, the yield-to-maturity $\iota(\delta)$ is such that the expected yield-discounted sum of coupon payments is equated to the price, i.e.

$$A(\delta) = \mathbb{E}\left[\int_0^{T_s} 1 \times e^{-\iota(\delta)t} dt\right], \tag{78}$$

where T_s is the random maturity rate. Since maturity follows a Poisson process with mean m_C, it then follows that $\iota(\delta) = 1/A(\delta) - m_C$. Taking expectations implies the following average yield-to-maturity

$$\text{yield to maturity} = \int_{\delta^*}^{\delta_H} \left[\frac{1}{A(\delta)} - m_C\right] \frac{\psi_0(\delta)}{\Psi_0(\delta_H) - \Psi_0(\delta^*)} d\delta. \tag{79}$$

Next, we need to (i) subtract the benchmark interest rate and (ii) add inflation to the yield (since we measure it in real terms) in order to arrive at the empirical measure in Beyhaghi and Ehsani (2017). Since we cannot observe the benchmark rates, we take the agnostic approach and assume it is about equal to the inflation rate. Thus, we set the right-hand side of (79) = 6.95%. If instead, we impose the benchmark rate to be the prime rate and lower our target by 2.5pp (which is roughly the empirical average difference between the prime rate and the inflation rate measured by the Consumer Price Index), the main results in our paper are qualitatively unchanged.