Financial Kuznets Facts

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Abstract

This paper studies the interaction between the sectoral allocation of credit and long-run economic development. We document a new set of *Financial Kuznets Facts*: as countries get richer, the share of manufacturing credit falls relative to value added, while the opposite is true for credit to the real estate sector. To jointly explain this structural transformation in credit markets and the real economy, we build a two-sector model with heterogeneous collateral constraints in which real estate output supports collateralized borrowing. In a quantitative calibration of our model, differences in sectoral productivity explain most of the structural change in the real economy, while the collateral constraints account more for structural change in credit markets. We provide empirical evidence supporting the relevance of these mechanisms and show that the share of manufacturing in outstanding credit is positively correlated with long-run growth. To understand the potential role of government interventions, we show that liberalizations of directed credit policies that channel credit to "priority sectors" are associated with a redistribution of credit from manufacturing to real estate. Taken together, our analysis suggests that financial frictions may play a role in structural transformation and long-run economic growth by influencing the allocation of credit.

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1 Introduction

This paper investigates the role of financial factors in structural transformation. While the move from agriculture to manufacturing to services over the course of economic development has been studied at least since Kuznets (1957), there has been relatively limited work on the role of finance. We seek to fill this gap by empirically, theoretically, and quantitatively examining the interplay between the sectoral allocation of credit and long-run economic development.

On the empirical front, we leverage an updated version of the Global Credit Project (Müller and Verner, Forthcoming) to document a new set of *financial Kuznets facts*: as countries become richer, the share of credit to the manufacturing sector decreases relative to its share in value added, while credit to the real estate sector sees a relative increase. Put differently, the credit-to-output ratio of manufacturing decreases with development while that of real estate increases. These patterns, based on a sample of 120 economies over the period 1940–2014, suggests that structural transformation in the credit market is far more pronounced than that in the real economy.

To understand the potential mechanisms behind these facts and their relationship to established patterns of structural transformation, we introduce a collateral constraint in the spirit of Kiyotaki and Moore (1997) into a workhorse supply-side structural change model as in Ngai and Pissarides (2007). In particular, we study a closed-economy two-sector general equilibrium model where firms use commercial land as an input for production and also face a collateral constraint for borrowing. Representative entrepreneurs in each sector have sector-specific total factor productivity (TFP), collateral input shares, and collateral constraints. They borrow from a patient saver via the financial market until their collateral constraint becomes binding. The manufacturing good is consumed, whereas the real estate good is transformed into residential housing services. What is key is that the real estate good has a dual function: besides its role in the aggregate consumption bundle, it also serves as collateral.

This tractable framework allows us to decompose structural change in credit and the real economy into three distinct underlying drivers: (1) the relative price of real estate goods and manufacturing, (2) the price of real estate, and (3) sectoral differences in real estate input shares in the presence of collateral constraints. In our model, sectoral differences in the reliance on real estate collateral are the only driver that has a direct effect on credit markets but no effect on the real economy.

Our model offers comparative statics to jointly explain structural changes in credit and the real economy. Throughout economic development, an increase in the manufacturing sector's Total Factor Productivity (TFP) amplifies the demand for both residential housing and housing collateral. The resulting higher demand for real estate goods drives up their price in general equilibrium. How credit and output develop over the course of development hinges on the elasticity of substitution between manufacturing good and residential housing service. Holding all else equal, if the elasticity of substitution is less than one, output migrates from manufacturing to real estate as countries become richer, as in Ngai and Pissarides (2007), and the same is true for credit.

Based on these forces alone, i.e. without financial frictions, we would expect there to be structural transformation in credit that mirrors that of output. In the data, however, structural transformation from the manufacturing to real estate sector is much more pronounced in credit than in output. We show that sectoral differences in the reliance on real estate as an input combined with a binding collateral constraint is crucial to quantitatively match these facts.

We provide several pieces of evidence to support the idea that collateral values may matter for structural transformation in the economy. We document that, as countries become richer, they see an increase in house prices and in the relative importance of real estate collateral (both among households and firms). We also show that aggregate credit growth is highly correlated with an increase in the real estate sector's share in total credit. These facts suggest that the price of real estate collateral increases over the course of economic development, consistent with our model, and that this increase in prices is accompanied by a wider use of real estate collateral in the economy.

Our model also implies that real estate credit reacts more to changes in the price of housing than manufacturing credit. We formally test for such sectoral differences in the elasticity of credit to house prices by estimating local projections. To mitigate potential issues of reverse causality, we build on the identification strategy in Guren, McKay, Nakamura, and Steinsson (2021), which we adapt to a cross-country setting. In particular, we instrument changes in house prices with the interaction of regional house prices and a country's co-movement with these regional changes. Our results suggest that an increase in house prices predicts stronger credit growth in sectors with a higher share of real estate collateral. This finding suggests that the increase in house prices over a country's development may translate into a reallocation of credit from manufacturing to the real estate sector, as in our model.

The reallocation of credit we document may not only be affected by the value of collateral firms can borrow against but also by the fraction of collateral they need to pledge. Put differently, the tightness of collateral constraints matters independent of any changes in the price of real estate. A first factor affecting how binding collateral constraints are in different sectors may come from technological change. As we show, higher levels of GDP per capita are associated with a marked increase in the share of intangible assets used by the manufacturing sector, but there is no such increase for real estate. Given that intangible assets are harder to redeploy and liquidate, they may also support a lower borrowing capacity than tangible assets (DellAriccia et al., 2021; Falato et al., 2022). The rising intangibility of assets in manufacturing over the course of development, in turn, may thus translate into a reallocation of credit towards the real estate sector.

We also explore the role of government policies in affecting the allocation of credit to different sectors. Many governments steer credit into "priority" sectors, often as a tool of industrial policy, both historically and today (Abiad et al., 2010). We interpret changes in these policies as shocks to the tightness of sector-specific collateral constraints. Some of the most prominent examples are the policies used during the East Asian "growth miracles." In *How Asia Works*, for example, Studwell argues that directing subsidized credit to manufacturing sectors exposed to global competition played a critical role in the rapid development of Japan, Korea, and China, and the failure to effectively implement such policies elsewhere explains the relative lack of development in other Asian economies. But targeted credit policies are not only used in developing countries. Under various monickers (directed credit, credit controls, credit ceilings, or window guidance), they played an integral role in the implementation of monetary policy in most advanced economies during the period of strong economic growth following World War II, e.g. in France (Monnet, 2014, 2018) and the United Kingdom (Aikman et al., 2016); also see Baron and Green (2023).

To understand the potential role of these policies in shaping the allocation of credit, we construct a new narrative-based chronology of liberalization events for 37 countries from a wide range of primary and secondary sources. In particular, we identify years in which these countries abandoned or considerably decreased the importance of directed credit policies targeting specific sectors. Because these policies generally aimed to subsidize manufacturers and prevent excessive lending for real estate purposes, we can interpret them as shocks to sector-specific financing constraints, similar to those in our model. The staggered nature of these policy changes allows us to test whether such shocks have a pronounced impact on the allocation of credit in the economy.

We find that the abolition of directed credit policies is followed by a reallocation of credit and output from manufacturing to real estate, and an increase in the credit-to-output ratio in the real estate sector. There is limited evidence for changes in sectoral TFP. These patterns suggest that shocks to financing constraints in a sector can accelerate structural transformation in credit and output even in the absence of changes in productivity, consistent with our model.[1]

To quantify the contribution of sectoral productivity shocks, changes in real estate prices, and changes in sector-specific collateral constraints in explaining the patterns of structural transformation in credit and output, we take the targeted moments from the data to calibrate our model. We evaluate the model at a steady-state equilibrium by varying the value of the same set of parameters for different income levels, which successfully captures changes in credit, output, real estate prices, and sectoral TFP over the course of development.

Using this quantitative model as a laboratory, we conduct a development accounting analysis similar to Caselli (2005). We find that changes in real estate prices by themselves would overstate the cross-country variation in the sectoral distribution of credit and output. Differences in productivity across sectors, on the other hand, would overstate these differences in the opposite direction. Intuitively, this is because higher TFP in the manufacturing sector will increase its real estate collateral input in partial equilibrium, but increases in house prices dampen this effect in general equilibrium. Our key finding is that sectoral differences in the reliance on real estate inputs, accounts for 85% of the observed structural transformation in credit and 51% of that in output from the partial equilibrium perspective. Through further decomposition, we find sec-

[1]Related work by Baron and Green (2023) finds that the abolition of credit ceilings in 13 countries is routinely followed by a boom-bust cycle in credit and output. They interpret the removal of such ceilings shocks to credit supply in the economy, while we focus on their role in steering credit to particular sectors.

toral TFP difference almost entirely account for the house prices increment, by contrast, looser financial constraint, especially in the real estate sector, if anything, will predict a relative lower house prices in richer countries.[2] Taken together, we find that cross country variation of collateral constraints explain 67.7% of credit market structural change, while sectoral TFP difference account for almost all of the real economy structural change.

To examine the potential relevance for structural changes in credit for a country's development trajectory, we document some stylized facts. We start by looking at the East Asian Growth Miracles as a case study. During the take-off phase, we find large increases in manufacturing credit in both Korea and Singapore. Despite their spectacular growth trajectory, these episodes were not accompanied by growth in credit to other sectors. We also document that, in our large cross-country panel dataset, a larger share of manufacturing credit is positively correlated with long-term economic growth. In contrast, we find that growth is negatively correlated with the share of credit to the real estate sector. While these patterns can at best be interpreted as suggestive, they suggest that the allocation of credit may play a role in economic development.

Related Literature The allocation of resources across sectors over the course of economic development has been studied since at least since Lewis (1954), Rybczynski (1955), and Kuznets (1957, 1973). It is well-known that economies shift from agriculture to manufacturing and then to services as countries get richer; see Herrendorf et al. (2014) and Lagakos and Shu (2024) for surveys. Previous research has proposed several mechanisms to account for these canonical "Kuznets facts."[3]. A separate literature has emphasized the role of financial factors in business cycle fluctuations, where a key idea is that such macro-financial linkages are amplified by the presence of collateral constraints (Kiyotaki and Moore, 1997; Bernanke et al., 1999).[4] A few papers have empirically studied the link between the allocation of credit to different sectors with recessions or financial crises (Büyükkarabacak and Valev, 2010; Jordà et al., 2016, 2015; Mian et al., 2020; Müller and Verner, Forthcoming).

Our paper sits at the intersection of these two strands of literature. To the best of our knowledge, we are the first to document the distribution of financial resources (credit) across different sectors over long-run economic development, which we call "financial Kuznets facts." The collateral channel we highlight builds on the idea from the supply-side structural change literature that, because the productivity in the manufacturing sector increases over development while that in

[2]This result coincides with Kiyotaki et al. (2011) that, in a different setting, improvement in productivity, instead of more relaxed financial constraints, is the key driver of house price changes.

[3]Among others, the proposed mechanisms include non-homothetic preferences (Kongsamut et al., 2001; Herrendorf et al., 2013; Comin et al., 2021), differences in sectoral productivity growth rates (Baumol, 1967; Ngai and Pissarides, 2007), differences in sectoral capital intensity along with capital deepening (Acemoglu and Guerrieri, 2008), the rise of the service economy (Buera and Kaboski, 2012; Fan et al., 2023), human capital accumulation (Porzio et al., 2021), skill-biased technological change (Buera et al., 2022), improvement of agriculture productivity (Matsuyama, 1992; Bustos et al., 2016), capital accumulation through financial integration (Bustos et al., 2020), and global imbalances (Kehoe et al., 2018)

[4]Empirical evidence on the link between credit and business cycles includes, among others, Schularick and Taylor (2012), Gourinchas and Obstfeld (2012), Jordà et al. (2016), Mian et al. (2017), and Brunnermeier et al. (2021).

real estate sector remains stagnant (Kirchberger and Beirne, 2023; Goolsbee and Syverson, 2023), the price of less productive goods (in our case, housing) increases with development (Baumol, 1967; Ngai and Pissarides, 2007). The idea that collateral constraints may affect structural transformation can also be interpreted as a "financial" analogue of Acemoglu and Guerrieri (2008), in the sense that an overall capital deepening leads resources to flow into more capital-intensive sectors, measured by a higher share of real estate inputs in our setting.

We also contribute to the broader literature on the role of finance in economic development (e.g., Greenwood and Jovanovic, 1990; King and Levine, 1993; Levine, 1997; Greenwood et al., 2010; Song et al., 2011). A century ago, Schumpeter (1911) pinpointed that credit, as a *productive force* for entrepreneurs, plays a vital role for economic development.[5] By contrast, the seminal work of Lucas Jr (1988) on economic development argues the role of finance is *popularly over-stressed*.[6] Our paper provides a new lens to revisit this long-standing debate by studying the role of finance in structural transformation, a key correlate of economic growth. Our quantitative results suggest a disconnect between structural change in credit and output: while transformation in the real economy is largely driven by differences in sectoral TFP growth, differences in the availability of collateral coupled with financing constraints are what matters most for the composition of credit.

Our work is also related to the macro-development literature, which argues that relaxing financial constraints facilitates a better selection into entrepreneurship (Evans and Jovanovic, 1989; Buera et al., 2011; Midrigan and Xu, 2014; Itskhoki and Moll, 2019) and reduces a misallocation of talents (Hsieh et al., 2019; Feng and Ren, 2023), which acts as a TFP-enhancing technology (Moll, 2014; Howes, 2022). Instead of affecting the *extensive* margin of who becomes an entrepreneur, the collateral constraint in our paper governs the firm financing decision on the *intensive* margin on the amount of collateral investment. Beyond the well-explored role of collateral constraints in business cycle fluctuations (Iacoviello, 2005; Gan, 2007; Chaney et al., 2012; Liu et al., 2013; Elenev et al., 2021), we underscore that the presence of collateral constraints can result in different rates of capital deepening across sectors as countries develop. Moreover, our quantitative results suggest a limited role of relaxing financial constraints on changes in house prices over development, which is similar with Kiyotaki et al. (2011).

[5]In Chapter 3 of Schumpeter (1911), *Credit and Capital*, Schumpeter states "By credit, entrepreneurs are given access to the social stream of goods before they have acquired the normal claim to it ... Granting credit in this sense operates as an order on the economic system to accommodate itself to the purposes of the entrepreneur, as an order on the goods which he needs: it means entrusting him with productive forces. It is only thus that economic development could arise from the mere circular flow in perfect equilibrium."

[6]Lucas Jr (1988) reiterates that "I believe that the importance of financial matters is very badly over-stressed in popular and even much professional discussion and so am not inclined to be apologetic for going to the other extreme. Yet insofar as the development of financial institutions is a limiting factor in development more generally conceived I will be falsifying the picture, and I have no clear idea as to how badly."

2 Financial Kuznets Facts

In this section, we document a new set of stylized facts about the financial side of the structural transformation and compare it with the well-known pattern that countries move from agriculture to manufacturing to services as they develop. In homage to the author first popularizing this pattern, we call these *Financial Kuznets Facts*.

Our data come from the *Global Credit Project*, a large cross-country database that breaks down outstanding credit in the economy into different sectors. The underlying data are drawn from hundreds of scattered sources, including statistical publications, data appendices from central banks and newly-digitized archival data. We refer interested reader to Müller and Verner (Forthcoming) for more details. In this dataset, credit refers to the end-of-period outstanding claims of financial institutions on the domestic private sector. We also add sectoral data on value added and employment, also taken from Müller and Verner (Forthcoming). Because we are interested in the broad patterns of structural changes, we aggregate these industry-level data into four sectors: agriculture, manufacturing, construction and real estate, and services.[7]

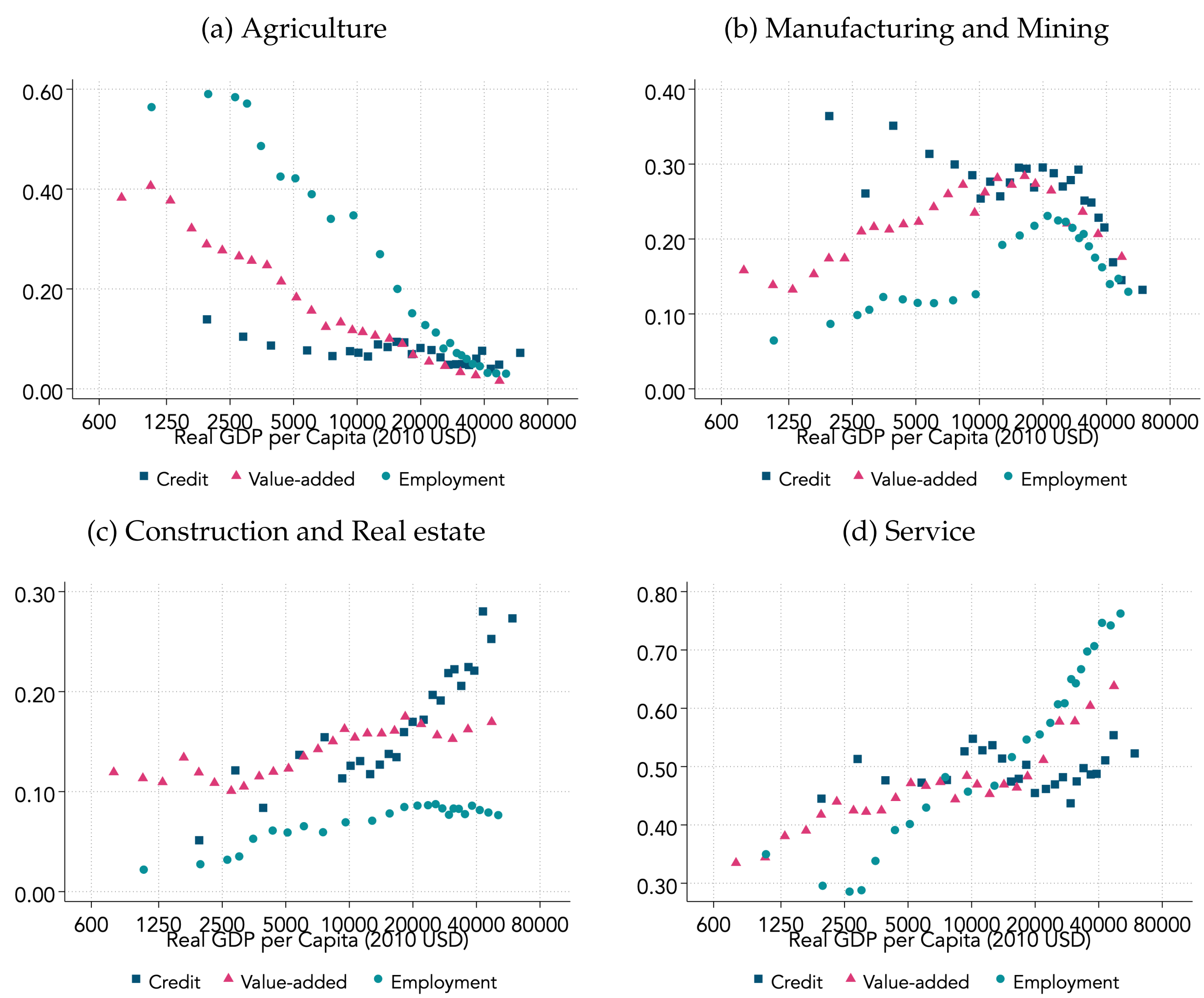
We focus on how factors and resources are allocated across sectors during the process of economic development. To do so, we compute the share of each sector in outstanding non-financial corporate credit, value added, and employment following the existing literature, surveyed by Herrendorf et al. (2014). For our main analysis, we restrict our sample to country-year observations with non-missing credit, value added, and employment for consistency. This sample contains 51 countries and 1,020 country-year observations, ranging from 1970 to 2014.

Figure 1 plots how the share of each sector in credit, value added, and employment varies across income levels. This reveals several interesting facts. First, our data successfully replicates the canonical "Kuznets facts" on structural transformation in the real economy: as countries become richer, the share of agriculture declines, the share of manufacturing first increases and then declines, and the share of the tertiary sector (including real estate) increases (Kuznets, 1973).

Second, structural changes in the credit market tell a different story. In contrast to the large decline in the share in employment and value added, credit to agriculture only mildly declines over the course of development and stays at around 10% for economies across all income levels. The service sector's share in credit does not vary a lot, unlike its salient increase in employment and value added. The most dramatic change in the allocation of credit is the shift from manufacturing to real estate. The share of manufacturing in credit falls much more than one would expect based on the sector's share in the real economy as countries become richer. The flipside of this decline is the sharp rise in real estate credit, which is considerably more pronounced than the increase in value added or employment.

[7]Given data limitations, the credit data often bulks together manufacturing (ISIC section C) with mining (section B), although the latter is a very small share of outstanding credit in almost every country. We compute the values for value added and employment equivalently to be consistent. For simplicity, we will refer to manufacturing and mining simply as "manufacturing" for the remainder of the paper.

Figure 1: Financial and Canonical Kuznets Facts



Note: These binscatter plots visualize the share of different sectors in outstanding non-financial corporate credit, value added, and employment over the course of economic development (measured by the natural logarithm of real GDP per capita).

A look at time series patterns suggests a similar picture. In Appendix Figure D.1, we also find that the real estate sector has risen in importance over time (relative to value added), and the opposite pattern for manufacturing. This adds nuance to the well-known fact that the ratio of total credit to the private sector relative to GDP has increased over time (Schularick and Taylor, 2012; Müller and Verner, Forthcoming). Tables E.1 to E.4 in Appendix E plot the results from regressions that replicate the same pattern, even when we include country or year fixed effects.

3 Model

To rationalize the empirical facts in Section 2, we build a two-sector general equilibrium model with two key features. First, entrepreneur faces a collateral constraint similar to Kiyotaki and Moore (1997), where real estate serves both as a production input and as collateral for debt. Second, we adopt the workhorse supply-side structural change model Ngai and Pissarides (2007) that structural transformation is driven by difference in productivity growth between manufacturing and real estate sector. We evaluate this tractable model at the steady state equilibrium, derive analytical comparative statics, and analyze the contribution of economic forces (change of sectoral TFP) and financial forces (change of collateral constraints) to the sectoral allocation of credit and output. We specify the model in Section 3.1 and organize the model predictions in Section 3.2. Proofs and extensions of the baseline model are in Appendix B.

3.1 Setup

Time is discrete and runs infinitely. A closed economy is populated with savers (denoted by H) and spenders (manufacturing and real estate entrepreneurs, denoted by M and E).[8] The manufacturing good is the numeraire.

Preferences Agent i consumes the manufacturing good c^i_t and housing service h^i_t each period, maximizing the life-long discounted utility,

$$\sum_{t=0}^{\infty}(\beta^i)^t\left[(c^i_t)^{\frac{\eta-1}{\eta}}+s(h^i_t)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{1}$$

where s is the weight of the housing service in the consumption bundle, and η is the elasticity of substitution.[9] We assume savers are more patient (Iacoviello, 2005), and entrepreneurs share the same discount factor with $\beta=\beta^M=\beta^E$.

Entrepreneurs The entrepreneur in sector j with productivity z^j_t operates firms using commercial land l^j_t as an input. The production function is given by $y^j_t = z^j_t(l^j_t)^{\alpha^j}$, with a sector-specific collateral input share $\alpha^j<1$. In each period, her flow of fund constraint is

$$c^j_t+q_t h^j_t+q_t\left[l^j_{t+1}-(1-\delta)l^j_t\right]+d^j_t=p^j_t y^j_t+\frac{d^j_{t+1}}{1+r_t}, \tag{2}$$

where q_t is the price of collateral or residential housing, r is the real interest rate, and δ is the depreciation rate. In each period, she earns the profit $p^j_t y^j_t$, raises new debt in real terms $\frac{d^j_{t+1}}{1+r_t}$, pays back the last period debt d^j_t, and invests in commercial land $l^j_{t+1}-(1-\delta)l^j_t$ at price q_t. On the consumption side, she consumes the manufacturing good c^j_t and residential housing service h^j_t.[10]

The maximum amount of debt raised by entrepreneur $d^{\lambda j}_{t+1}$ is proportionate to the resale value

[8]As a convention, we index entrepreneurs or sectors using $j\in\{M,E\}$, and index agents, including savers and entrepreneurs, using $i\in\{S,M,E\}$.

[9]The housing service can be interpreted as the demand shifter for housing as in Liu et al. (2013) or the housing demand channel of a credit expansion as in Mian et al. (2017).

[10]The residential housing service is a *flow* variable. This assumption keeps our model analytically tractable such that, at the steady state, for all agents i, $c^i/h^i=(q/s)^\eta$. This provides a simple aggregation rule so that we do not need to track the redistribution of consumption across agents when analyzing comparative statics. The result is quantitatively similar if we assume agents make residential housing investments.

of current period collateral $q_{t+1}l^j_{t+1}$, following[11]

$$d^j_{t+1} \leq \lambda^j q_{t+1} l^j_{t+1}, \tag{3}$$

Rest of the Model The saver consumes c^S_t and h^S_t and saves $\frac{b_{t+1}}{1+r_t}$, i.e., $c^S_t + q_t h^S_t + \frac{b_{t+1}}{1+r_t} = b_t$. The manufacturing good is consumed, $y^M_t = \sum_i c^i_t$, and real estate output is invested by entrepreneurs as collateral or consumed by agents as residential housing service each period, $y^E_t = \sum_i h^i_t + \sum_j [l^j_{t+1} - (1-\delta)l^j_t]$. The financial market clears with $b_t = \sum_j d^j_t$.

3.2 Model Predictions

In Appendix B, we define the steady state equilibrium, prove its uniqueness and other propositions, and provide auxiliary results. Here, we summarize the main model properties and predictions.

Financially Constrained Economy For each sector, collateral constraints are binding at the steady states. Intuitively, savers are more patient, who provide the debt elastically, pricing it at $r = 1/\beta^S - 1$ (Iacoviello, 2005).

Collateral Price Passthrough Entrepreneur equalizes the marginal benefit and user cost of collateral usage, choosing

$$l^E = (\alpha^E z^E \widetilde{\lambda}^E)^{\frac{1}{1-\alpha^E}}, \quad l^M = (\alpha^M z^M \widetilde{\lambda}^M / q)^{\frac{1}{1-\alpha^M}}. \tag{4}$$

The marginal benefit of collateral usage comes from two terms: (1) marginal revenue production of collateral, and (2) the marginal benefit of relaxing flow of fund constraint due to more collateral. Equation 4 suggests that l^E does not vary with the collateral price q; while l^M decreases with q. The intuition is that, for the real estate sector, a higher q affects revenues and costs simultaneously, which are cancelled out. But in the manufacturing sector, a higher q solely increases the user cost of collateral, and thus depresses demand of collateral. Moreover, from a partial equilibrium (PE) perspective, a higher level of collateral intensity in production α^j, an increase in sector TFP z^j, and a less binding collateral constraint, represented by higher λ^j, raise the incentive to use more collateral as input in that sector.[12]

The model describes the price elasticity of debt for both sectors and characterizes how the

[11] Our specified collateral constraint is similar to (Kiyotaki and Moore, 1997; Iacoviello, 2005; Liu et al., 2013; Catherine et al., 2022), which parsimoniously models a costly contract enforcement scenario. In reality, λ^j may change due to credit policies (Buera and Shin, 2013; Itskhoki and Moll, 2019), improved legal systems to enhance creditor rights (Djankov et al., 2007), or financial regulation or development (e.g., Rajan and Zingales, 1998; Liu et al., 2013).

[12] Denote $\widetilde{\lambda}^j \equiv \frac{\beta}{1-\beta(1-\delta)-\lambda^j(\beta^S-\beta)}$, which increases with λ^j.

sectoral allocation of credit changes as the price of collateral increases. Holding all else equal,

$$\varepsilon^j_{dq} \equiv \frac{\partial \log d^j}{\partial \log q} = 1 + \frac{\partial \log l^j}{\partial \log q} = \begin{cases} 1 & \text{if } j = E, \\ -\frac{\alpha^M}{1-\alpha^M} & \text{if } j = M. \end{cases} \tag{5}$$

These *PE* comparative statics imply that an increase in the price of collateral will have an *asymmetric* effect on credit growth in different sectors. In the real estate sector, a 1% increase of q leads to a 1% increase of collateral values. By contrast, increasing the collateral price has an additional *price* effect discouraging collateral usage by $\frac{1}{1-\alpha^M}$ percent for the manufacturing sector, which we can see from Equation 4. This *quantity* effect overpowers the *price* effect, leading to $\frac{\alpha^M}{1-\alpha^M}$ percent decline in manufacturing credit. Suppose the collateral price soars over economic development, due to this asymmetric collateral price passthrough, we expect to see relative more credit in real estate sector relative to manufacturing sector.

Decomposition Rules This tractable model provides a simple formula for the sectoral distribution of credit and output. Specifically, we can decompose changes in sectoral credit and output multiplicatively into three channels: the relative productivity channel $\mathbf{Z}$, the collateral price channel $\mathbf{Q}$, and the reliance on real estate channel $\mathbf{\Lambda}$.

$$\frac{d^E}{d^M} = \frac{\mathbf{Z}^E}{\mathbf{Z}^M}\frac{\mathbf{\Gamma}^E_d}{\mathbf{\Gamma}^M_d}\mathbf{Q}, \quad \frac{qy^E}{y^M} = \frac{\mathbf{Z}^E}{\mathbf{Z}^M}\frac{\mathbf{\Gamma}^E_y}{\mathbf{\Gamma}^M_y}\mathbf{Q}, \tag{6}$$

where

$$\mathbf{Z}^j = (z^j)^{\frac{1}{1-\alpha^j}}, \quad \mathbf{Q} = q^{\frac{1}{1-\alpha^M}}, \quad \mathbf{\Gamma}^j_d = \lambda^j(\alpha^j\widetilde{\lambda}^j)^{\frac{1}{1-\alpha^j}}, \quad \mathbf{\Gamma}^j_y = (\alpha^j\widetilde{\lambda}^j)^{\frac{\alpha^j}{1-\alpha^j}}$$

Relative productivity ($\mathbf{Z}$) and the price of collateral ($\mathbf{Q}$) matter identically for the share of each sector in credit and output. The discrepancy between structural transformation in credit and the real economy comes entirely from the reliance on real estate channel $\mathbf{\Gamma}$, determined by (i) the reliance on real estate in production, governed by α^j, and (ii) the debt reliance on real estate collateral, captured by λ^j. As indicated in Equation 4, looser financial constraints affect the allocation of collateral, which boosts sectoral output, captured by $(\alpha^j\widetilde{\lambda}^j)^{\frac{\alpha^j}{1-\alpha^j}}$. Besides this collateral allocation effect, financing constraints also directly impact a sector's debt capacity, captured by the first term of $\mathbf{\Gamma}^j_d$: holding the collateral price fixed, for every additional unit of collateral usage, sectoral debt increases by λ^j unit.

Determination of the Collateral Price Both relative productivity and collateral constraints are determined by the exogenous parameters of the model, while the collateral price is an endogenous object. To determine q, the market clearing condition for real estate output is satisfied, written as:

$$\overbrace{z^E(\underbrace{\widetilde{\zeta}^E}_{l^E})^{\alpha^E} - \delta\widetilde{\zeta}^E}^{\text{Residual Supply}} = \overbrace{\underbrace{\widetilde{\zeta}^H q^{-\eta-\frac{\alpha^M}{1-\alpha^M}}}_{h(q)} + \delta\underbrace{\widetilde{\zeta}^M q^{-\frac{1}{1-\alpha^M}}}_{l^M(q)}}^{\text{Aggregate Demand}}, \tag{7}$$

where $\widetilde{\zeta}^j \equiv (\alpha^j z^j \widetilde{\lambda}^j)^{\frac{1}{1-\alpha^j}}$ for $j \in \{M, E\}$ and $\widetilde{\zeta}^H \equiv s^\eta z^M(\widetilde{\zeta}^M)^{\alpha^M}$.

Equation (7) is intuitive: the left hand side is the *residual supply* of the real estate good, the difference between output y^E and collateral investment δl^E in that sector at the steady states, which is invariant with q from Equation 4. The right hand side includes downward sloping residential housing demand $h(q)$ and the manufacturing sector's commercial land investment $\delta l^M(q)$ with price elasticity of demand $-\eta - \frac{\alpha^M}{1-\alpha^M}$ and $-\frac{1}{1-\alpha^M}$, respectively. This *aggregate demand* curve for real estate output intersects with the inelastic residual supply curve, which guarantees that a unique q clears the market at the steady state.[13]

The following proposition showcases how the collateral price q varies with the exogenous parameters.

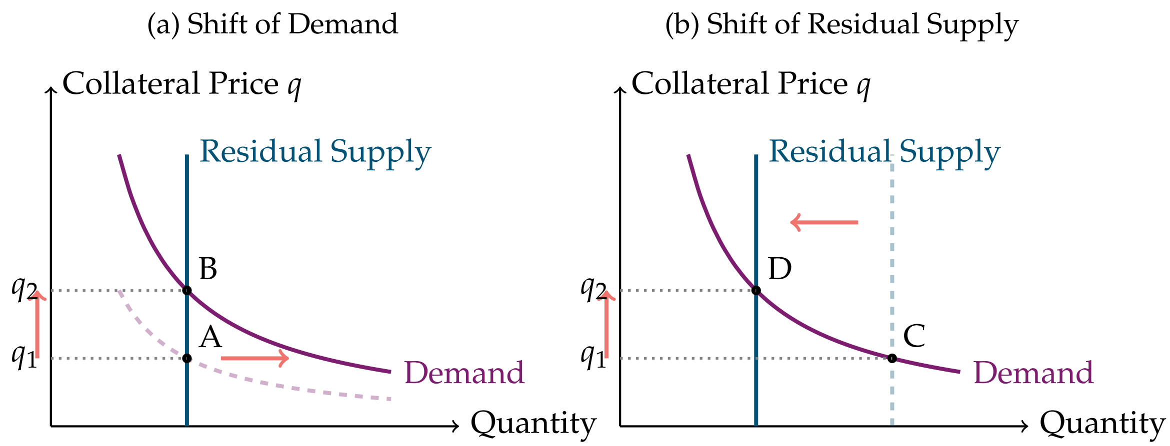
Proposition 1 (Collateral Price)**.** *Holding all others fixed,*

1. *q increases with z^M and λ^M, as well as s;*
2. *the elasticity of the collateral price q with respect to z^M, denoted by $\varepsilon_{q,z^M} \equiv \frac{\partial \log q}{\partial \log z^M}$ is 1 if $\eta = 1$, greater than 1 if $\eta < 1$, and less than 1 if $\eta > 1$;*
3. *if the financial constraint is relatively binding, i.e. $\widetilde{\lambda}^E < 1/\delta$, the supply effect dominates such that q decreases with z^E and λ^E; otherwise, the demand effect dominates such that q increases with z^E and λ^E.*

To gain some intuition for Proposition 1, Figure 2 plots the residual supply and aggregate demand for the real estate good. Suppose there is an increase of z^M, as in Figure 2a. Both the demand curves $l^M(q)$ and $h(q)$ shift to the right, resulting in an overall shift in aggregate demand. The residual supply, however, remains unchanged. Consequently, the equilibrium moves from point A to B with a boost in the price of collateral q. A similar analysis applies a the scenario where financial constraints become less binding. For example, an increase in λ^M acts like an increase in manufacturing TFP (Buera and Shin, 2013; Itskhoki and Moll, 2019; Howes, 2022), leading to an increase in the price of collateral. Moreover, a higher s, potentially due to a housing demand boost as in Mian, Sufi, and Verner (2020), makes households spend more on the residential housing service, which shifts $h(q)$ to the right and boosts the collateral price q. This is in line with the intuition in Liu et al. (2013) where competing demand between residential housing and the manufacturing sector's commercial land pushes up the collateral price in a credit-constrained economy.

[13] As $q \to 0$, the right hand side approaches to $+\infty$, while as $q \to \infty$, it approaches to 0.

Figure 2: Determining the Price of Collateral



Note: These figures illustrate how residual supply and demand determine the price of collateral in the steady state equilibrium. The horizontal axis is the quantity of residual supply or demand, and the vertical axis is the collateral price q. Panel (a) illustrates the case of an increase in z^M, λ^M or s shifting the demand curve to the right, from the dashed pink line to the solid pink line. The equilibrium moves from point A to B, along with a rising collateral price from q_1 to q_2. Panel (b) illustrates the case of the real estate sector's collateral constraint being relatively loosened, i.e. when $\lambda_* < \lambda^E < \lambda^E_{max}$, such that the collateral effect dominates, where an increase of z^E or λ^E shifts the residual supply curve to the left, from the dashed blue line to solid blue line. The equilibrium moves from point C to D, along with a rising collateral price from q_1 to q_2.

The second part of Proposition 1 presents the determination of the elasticity of the price of collateral with respect to z^M, which measures the percentage change of q in response of percentage change of z^M. This elasticity is essential for understanding how collateral usage in the manufacturing sector changes in equilibrium with z^M, taking into account both partial equilibrium and collateral price effects. Recall that in Equation (4), we have $l^M \propto (z^M/q)^{\frac{1}{1-\alpha^M}}$. To illustrate this idea, we start with a simple case when $\eta = 1$. A rising cost of the collateral input exactly cancels out the increasing demand for collateral for the manufacturing entrepreneur, i.e., l^M does not change. Thus, the demand elasticity for both residential housing and the manufacturing sector's commercial land investment are $-\frac{1}{1-\alpha^M}$. Meanwhile, the Cobb-Douglas utility function cancels out income and substitution effects, such that $qh/c = s$. Under this scenario, this implies that the elasticity of the collateral price with respect to z^M, ε_{q,z^M}, equals one. When $\eta < 1$, the income effect overpowers the substitution effect, putting upward pressure on the collateral price relative to the case with $\eta = 1$. Hence, $\varepsilon_{q,z^M} > 1$ when $\eta < 1$. A similar analysis applies when $\eta > 1$.

The last part of Proposition 1 focuses on the shift of the residual supply curve. Consider a scenario where the real estate sector's financial constraints are relaxed. Due to two counterbalancing forces, the change in the collateral price is *state-dependent*: (1) rising revenues drive up the supply, and (2) there is growing demand for real estate collateral. When financial constraints become relatively binding with $\widetilde{\lambda}^E < 1/\delta$, the *supply effect* dominates.[14] As shown in Figure 2, the residual supply curves move to the right, the equilibrium moves from C to D, and the collateral price goes

[14] When the supply and demand effects offset each other, the level of collateral usage in the real estate sector is exactly the capital level with golden rule saving rate in the Solow-Swan model.

up.

Structural Change in the Credit Market and Real Economy We use the aforementioned properties of the collateral price in Proposition 1 and combine them with our accounting identity (6). We summarize the process of structural transformation in the credit market and in the real economy over the course of development in the following proposition.

Proposition 2 (Financial and Canonical Kuznets Facts)**.** *Holding all else equal,*

1. *(Sectoral TFP) both the relative output shares qy^E/y^M and relative credit shares d^E/d^M do not change with z^M if $\eta = 1$, increase with z^M if $\eta < 1$, and decrease with z^M if $\eta > 1$;*
2. *(Sectoral Financial Constraints) the relative output share of real estate qy^E/y^M increases with λ^E and λ^M; the credit share d^E/d^M increases with λ^E and χ^E if $\eta = 1$;*

The first part of Proposition 2 suggests a similarity between structural change in finance and the real economy. As in the supply side structural change literature pioneered by Ngai and Pissarides (2007), when $\eta < 1$, resources are allocated from the faster-growing manufacturing sector to the stagnant real estate sector, an analogue of Baumol's cost disease. In this way, structural change in the credit market is *nothing special* compared to that in the real economy.

In the second part of Proposition 2, we intend to shut down this mechanism. When $\eta = 1$, a sector's share in credit and output do not depend on its TFP. Surprisingly, improvements in the financial system, characterized by more relaxed financial constraints, can shift output to the real estate sector. On one hand, this works through the equilibrium price of collateral, since increases in λ^j and/or χ^j act like an improvement of sectoral TFP. On the other hand, because of the presence of collateral constraints, there is a reallocation in the distribution of collateral across sectors through a PE effect. Turning to the credit market, an increase in λ^E and/or χ^E boosts the relative share of the real estate sector in credit for two reasons: (1) it directs output towards the real estate sector, and (2) it boosts the sector's debt capacity. We do not have a general result for the manufacturing sector, since these two factors move in opposite directions.

Taken together, Proposition 2 highlights that variation in sectoral TFP or financial constraints over the course of development are sufficient to have an impact on structural transformation in credit and the real economy. Moreover, the first part of Proposition 2 highlights some similarities in the drivers of structural change in credit and output. The following proposition showcases when these two will diverge.

Proposition 3 (Sectoral Credit to Value Added and Mortgage Share)**.** *Both a sector's credit-to-output ratio κ^j and share of real estate collateral ω^j depend on (1) the sectoral collateral elasticity in the production function α^j, and (2) the slackness of the financial constraints λ^j and χ^j,*

$$\kappa^j \equiv \frac{\lambda^j q l^j}{p^j y^j} = \alpha^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j + \chi^j, \quad \omega^j \equiv \frac{\lambda^j q l^j}{d^j} = \frac{\alpha^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j}{\kappa^j}$$

Proposition 3 highlights that changes in the price of collateral do not pass through to the sectoral credit-to-output ratio. Rather, such changes are driven by a sector's share of real estate as an input and its collateral constraint. This result directly comes from the Cobb-Douglas production function such that the collateral value ql^j is proportionate to the revenue $p^j y^j$. Hence, the total amount of debt is linear with $p^j y^j$.[15] From the sectoral credit-to-output ratio, we know that the discrepancy between structural change in credit and the real economy comes from the parameters related to the usage of collateral. Intuitively, a higher share of collateral as an input and less binding financial constraints (either higher λ^j or χ^j), holding all else fixed, lead to a higher credit-to-output ratio. Inside this ratio, we further dissect the contribution of collateral as an input for total debt, captured by the share of real estate collateral. This time, holding all others fixed, a larger λ^j leads to higher real estate collateral share. However, a larger χ^j increases the share of cash flow-based financing, and thus reduces the reliance on real estate collateral. Additionally, these two moments are crucial for us to identify financial constraints parameters, which are normally hard to obtain.[16]

Taking Stock This section develops some intuition for structural transformation in the credit market and the real economy based on a simple model. Manufacturing TFP grows as countries develop, while productivity in the real estate sector is stagnant. This increases the demand for collateral in the manufacturing sector, which drives up the price of collateral. Because the real estate sector uses more of this collateral, this leads to a reallocation of credit from manufacturing to real estate. Additionally, over the stage of development, less binding financial constraints contribute to a higher debt capacity, which affects the composition of credit and output.

4 Evidence on the Collateral Channel of Structural Transformation

In this section, we empirically examine the role of real estate collateral in structural change as specified by our model. Section 4.1 documents an increasing importance of real estate collateral as countries become richer. In particular, we show that both the prevalence of such collateral increases as well as its value, as proxied by house prices. We also document a clear relationship between a country's reliance on real estate collateral and growth in total credit. Section 4.2 formally tests for a link between the price of collateral and sectoral credit growth. Section 4.3 provides evidence on the potential role of collateral constraints from two perspectives: the increasing

[15] Our results hold under a more general case, see Proposition in Appendix B.3. The sectoral credit-to-output ratio consists of two components: one is χ^j, the ratio of cash flow-based borrowing to total revenue; and the other one is $\alpha^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j$, where $\alpha^j \widetilde{\lambda}^j \widetilde{\chi}^j$ are the costs of the collateral relative to the total revenue, and λ^j is the loan to value ratio from asset-based borrowing.

[16] As mentioned before, higher λ^j and χ^j contribute to a higher κ^j. However, their effects on ω^j are in the opposite direction: ω^j increases with λ^j but decreases with χ^j. These two moments allow us to separate these two forces in asset based and cash flow-based borrowing for a fixed α^j. In Appendix B.3, we formally elaborate on this intuition using the *isomoment curve* developed in David and Venkateswaran (2019).

importance of intangible assets in the manufacturing sector (but not real estate) as countries get richer in Section 4.3.2, and how the liberalization of directed credit policies can affect the allocation of credit in Section 4.3.3.

4.1 Real Estate Collateral, Credit Growth and Development

To begin, we study how the price and prevalence of real estate collateral change over the course of economic development.

To proxy for changes in the price of collateral, we look at house price indices. In particular, we construct a house price index using the Bank for International Settlement's residential property price series, OECD data on house prices, the Dallas Fed International House Price Database, and additional data from Jordà et al. (2017). Figure 3a shows a binscatter plot of a country's house prices against its GDP per capita. Since housing price indices are not comparable across countries, we include country fixed effects, which means we only exploit variation in house prices within a country over time. The resulting pattern is striking: there is an almost linear positive relation between real GDP per capita and house prices.

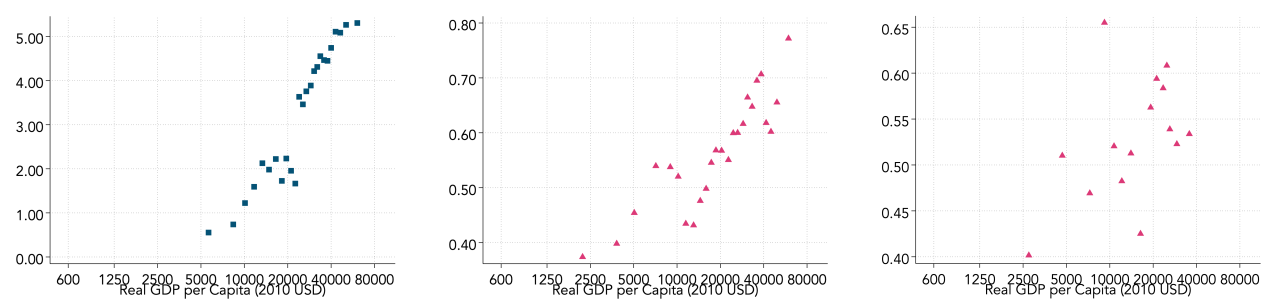
Next, we look at the reliance on real estate collateral in the economy using two measures: the share of household credit accounted for by residential mortgages, compiled from the data in Müller and Verner (Forthcoming), and firms' reliance on real estate as collateral computed from BEEPS survey data. Both measures suggest that richer economies use substantially more real estate collateral, both in the household and corporate sectors, as shown in Figure 3b and 3c.

Figure 3: Real Estate Collateral and Development

(a) House Prices

(b) Share of Residential Mortgages in Household Credit

(c) Share of Real Estate Collateral in Firm Credit



Note: These figure show stylized facts on the importance of real estate collateral and its valuation over the course of economic development. Figure 3a plots log real house prices, compiled from the Bank for International Settlement's residential property price series, OECD, Dallas Fed International Housing Price Database, and Jordà et al. (2017). We include country fixed effects since house price indices are only comparable within a given country. Figure 3b plots the ratio of residential mortgages to household credit constructed from the Global Credit Project (Müller and Verner, Forthcoming). Figure 3c is the real estate collateral share in firm credit, weighted by logged sales. We use the BEEPS survey (2002, 2004, 2005, 2009, 2011-2015, 2018-2020) to calculate these statistics for countries where we have more than 20 observations. Due to the sparse nature of this data source, we restrict the number of bins to 15.

4.2 Collateral Price Channel: House Price Passthrough to Sectoral Credit

In this section, we investigate how the elasticity of credit with regard to house prices differs across sectors, as implied by Equation (5) in our model. The key intuition we would like to test is whether, as suggested by the model, credit in sectors with a higher reliance on collateral, such as real estate, respond more strongly to changes in the price of the underlying collateral.

Baseline Local Projections To empirically test this hypothesis, we estimate the path of sectoral credit growth after an innovation to the house price index using impulse responses obtained from local projections (LP), as outlined in Jordà (2005),

$$\Delta_h y^j_{c,t+h} = \alpha^h_c + \sum_{l=0}^{L} \beta^j_{h,l} \Delta_1 \log\left(\mathrm{HPI}_{c,t}\right) + \sum_{l=0}^{L} \gamma^j_{h,l} \Delta_1 y^j_{c,t-l} + \sum_{l=1}^{L} \theta^j_{h,l} X^j_{c,t-l} + \epsilon^j_{c,t+h}, \tag{8}$$

for $h = 1, \cdots, H$, where $\Delta_h y^j_{c,t+h}$ represents the change in sectoral credit from t to $t+h$, and α^h_c denotes country fixed effects. We control for the path of sectoral TFP and credit to value added ratio $X^j_{c,t-l}$, motivated by the partial derivative nature in Equation 5. We opt for a time window of $H = 10$ to study long-run impacts and a conservative lag length of $L = 5$, in line with the recommendations in Montiel Olea and Plagborg-Møller (2021).

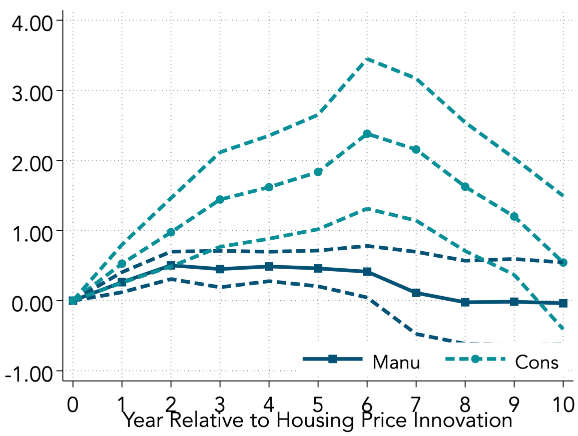
Figure 4a illustrates how manufacturing and real estate credit respond to an innovation in house prices. Specifically, a one percentage increase in house prices in year t is associated with a 2.3 percent growth in real estate credit in year $t+6$. This response is statistically significant over a 10-year time horizon. By contrast, the response of manufacturing credit is less pronounced, at about half a percentage point, and is not statistically significant after year $t+6$.

In Figure 4b, we replicate this analysis for five broad industries. We rank the collateral usage intensity of these industries according to the share of outstanding credit backed by real estate collateral, for which we obtain data from five economies: Denmark, Latvia, Switzerland, Taiwan, and the US; see Müller and Verner (Forthcoming) for details. Due to the availability of sectoral value added data, we do not include sectoral TFP and credit to value added as controls to increase our sample size. Nonetheless, our main results persist even in these finer sector categories. In addition to the manufacturing and real estate sectors, the response of sectoral credit to the change in HPI is more pronounced in sectors with a higher reliance on real estate collateral, such as agriculture (Section A), and less noticeable in those with a lower reliance, including wholesale and retail trade, accommodation, and food services (Sections G and I), as well as transportation and communications (Sections H and J).

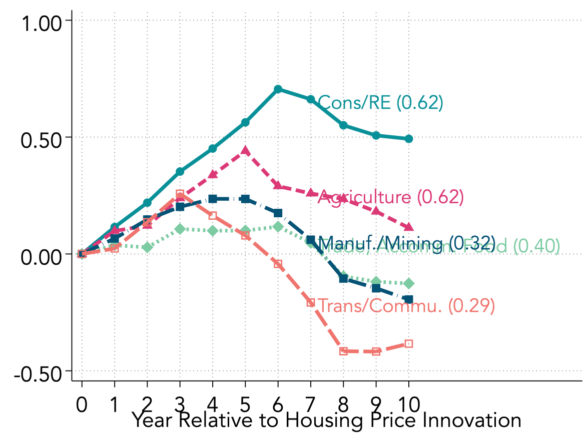
A Local Projection Instrumental Variables Approach Our baseline estimation results do not necessarily capture the causal effect of house prices on credit because these variables may be jointly determined. For example, a credit expansion may stimulate house price growth (Favara and Imbs, 2015; Greenwald and Guren, 2021; Mian and Sufi, 2022) and the credit booms often linked to house price booms are more concentrated in non-tradable sectors such as real estate

Figure 4: Local Projection: Housing Price Pass-Through to Sectoral Credit

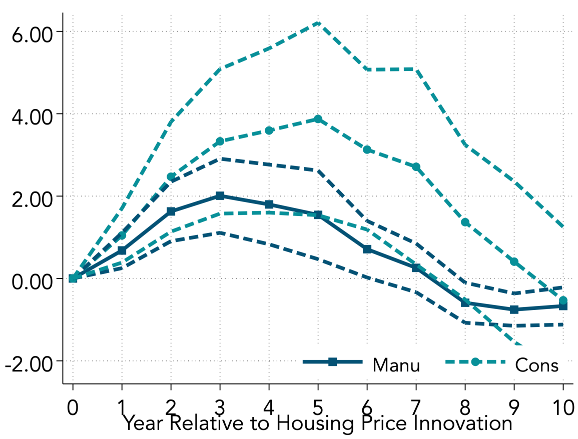
(a) LP: Manufacturing and Real Estate



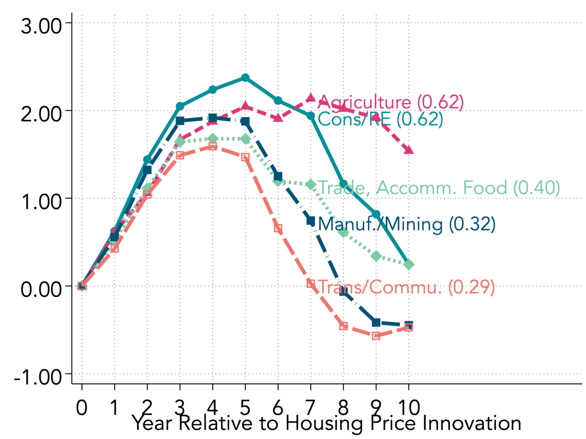
(b) LP: Sectors Ranked by Mortgage Share



(c) LP-IV: Manufacturing and Real Estate



(d) LP-IV: Ranked by Mortgage Share



Note: These figure plot local projections following specification (8). Panel (a) plots the sequence of $\{\widehat{\beta}^{j}_{h,0}\}$ for manufacturing and real estate, controlling for lagged sectoral TFP and credit to value added in logs. Dashed lines represent 90% confidence intervals computed using (Driscoll and Kraay, 1998) standard errors. Panel (b) plots a similar sequence of more industries by adding agriculture; trade, accommodation and food services; transportation and communication. Due to the availability of sectoral value added and credit to value added data, we do not control for them in Panel (b). The number in parentheses is the share of real estate collateral used in each industry.

relative to tradable sectors such as manufacturing (Müller and Verner, Forthcoming). To address this issue, we follow the intuition in Guren, McKay, Nakamura, and Steinsson (2021) to construct an instrumental variable exploiting differences in a country's sensitivity to regional house price cycles, building on earlier work by Saiz (2010) and Palmer (2022). The intuition behind this strategy is that a country's house prices should have a stronger correlation with other countries in the same sub-continent.

To implement this strategy, we estimate the following regression for each country c:

$$\Delta_1 \log(\mathrm{HPI}_{c,t}) = \varsigma_c + \vartheta_c \Delta_1 \log(\mathrm{HPI}_{r(c),t}) + e_{c,t}, \tag{9}$$

where ϑ_c measures the response of the house price index (HPI) in country c to changes in house prices in subcontinent $r(c)$. Appendix Figure D.6 shows the distribution of the estimated elasticities $\widehat{\vartheta}c$. Next, we construct the interaction term of this housing elasticity and regional housing price fluctuations, ${}_1Zc, t = \widehat{\vartheta}c\Delta_1 \log(\mathrm{HPI}_{r(c),t})$, as the instrumental variable for $\Delta_1 \log(\mathrm{HPI}_{c,t})$ in the baseline local projection (8). The identification assumption for the local projection instrumental variable approach (LP-IV) requires that the instrument is relevant and exogenous at all leads and lags. Following Ramey (2016) and Ramey and Zubairy (2018), we include 2 lags of the instrument in the first stage. Figures 4c and 4d display the LP-IV estimation results. The point estimates show a magnitude approximately twice that of the baseline local projection. However, our main results remain qualitatively unchanged: for industries with a higher reliance on real estate collateral, such as agriculture and construction/real estate, the response of sectoral credit to a house price shock is more pronounced.

Robustness Checks We conduct two robustness checks for estimating the elasticity of different types of credit to changes in house prices: (1) estimating the elasticity using a bi-variate regression for different time horizons with and without the use of the instrumental variable; and (2) estimating it directly from cross-sectional data. By and large, the results in Appendix Table E.7 and E.8, with various controls and fixed effects, are congruent with our previous findings.

4.3 What Drives The Increasing Importance of Real Estate Credit?

Guided by our model, the role of collateral constraints in explaining structural changes in credit and output can be summarized as $\mathbf{\Lambda}_d^j = \kappa^j \Gamma_y^j$. κ^j is the effect of debt capacity, summarized by the ratio of credit to output in sector j. Γ_y^j is the input share of collateral on the production side. In this section, we provide evidence for the empirical relevance of the debt capacity effect. As a starting point, Section 4.3.1 shows a positive correlation between reliance on collateralized credit and credit growth. We also study empirically two potential sources of changes in sector-specific financial constraints λ^j: (1) the increasing reliance on intangible assets in the manufacturing sector as countries develop in Section 4.3.2, and (2) changes in the regulation of credit markets that explicitly tax (or subsidize) lending to particular sectors ("directed credit") in Section 4.3.3.

Table 1: A Higher Share of Real Estate Collateral Predicts Higher Credit Growth

	$\Delta_h \log(\text{Credit}_{c,j,t})$					
	$h=5$			$h=10$		
	(1)	(2)	(3)	(4)	(5)	(6)
Mortgage Share	1.33***	0.11***		2.78***	0.28***	
	(0.26)	(0.023)		(0.40)	(0.034)	
Δ_hMortgage to $\text{GDP}_c \times \mathbf{1}\{j = \text{Cons.}\}$			3.87***			4.09***
			(0.19)			(0.18)
Δ_hMortgage to $\text{GDP}_c \times \mathbf{1}\{j = \text{Manu.}\}$			1.03***			1.04***
			(0.15)			(0.17)
Observations	280	15,520	1,668	185	12,752	1,338
# Countries	4	112	34	4	110	29
# Industries	5	5	2	5	5	2
Country FE			✓			✓
Year FE			✓			✓
Country×Year FE	✓	✓		✓	✓	
Industry×Year FE	✓			✓		
Industry Level	Broad	Broad	Broad	Broad	Broad	Broad
Mean of Dependent Var.	0.16	0.30	0.26	0.32	0.58	0.52
R^2	0.89	0.75	0.51	0.90	0.85	0.61

Notes: This table reports the relation between a sector's future growth in credit and its reliance on real estate collateral at a 5-year or 10-year time horizon in a country-industry-year panel. In column 1 and 4, the sample is restricted to the four countries where we have data on a sector's real estate collateral intensity *and* sectoral credit data (Denmark, Latvia, Switzerland, Taiwan). *, ** and *** denote significant at the 10%, 5% and 1% level.

4.3.1 Real Estate Collateral and Credit Growth

As indicated in our model, the role of collateral constraints matters more for sectors with a higher share of real estate inputs, which then translates into a higher growth rate of credit. We use the following specification to test this hypothesis:

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta^h \text{Mortgage Share}_{c,j} + \text{Fixed Effects} + \epsilon_{c,j,t}, \text{ for } h = 5, 10, \tag{10}$$

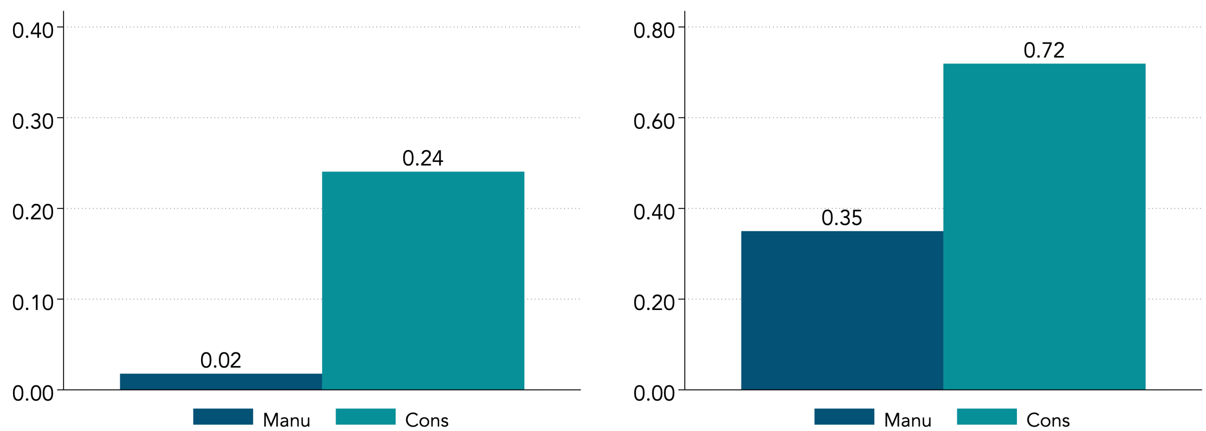
where $\Delta_h \log(\text{Credit}_{c,j,t})$ represents the change in credit to industry j deflated by the Consumer Price Index (CPI) in country c from time t to $t+h$. We estimate this specification for different time horizons, controlling for country-year and industry-year fixed effects, and exploiting cross-sectional variation in the reliance of different sectors on real estate as collateral.

Column 1 and 4 exploit variation on the country-industry level in the reliance on real estate as collateral. The coefficients of 1.33 and 2.78 (statistically significant at the 1% level) suggest that a 10% higher intensity of real estate use is associated with a 13.3% to 27.8% higher credit growth over a 5-year and 10-year horizon, respectively. However, we can only run this estimation for the four countries for which we can measure both a sector's real estate collateral intensity and sectoral credit. To overcome this limitation, we compute each industry's *average* reliance on real estate and use it as the independent variable in Column (2) and (5).[17] We find somewhat smaller coefficients, but our results still holds qualitatively. Lastly, we exploit changes in the reliance on real estate collateral over time as proxied by changes in mortgage credit to GDP within an economy. The results in Column (3) and (6) suggest that a 10% increase of mortgages relative to GDP is associated with a 10.3% increase of credit to manufacturing and a 38.7% increase of that to real estate.

Figure 5: Collateral Usage: Manufacturing and Construction

(a) Real Estate Input Share

(b) Mortgage Share



Note: These figures show how the reliance on real estate as a production input and as collateral differs between the manufacturing and construction sector.Figure 5a is based on data from the World Input-Output Database (Timmer et al., 2015). Figure 5b is based on data on the reliance on real estate collateral from Müller and Verner (Forthcoming).

How does the relationship between the use of real estate collateral and credit growth mesh with the financial Kuznets facts of credit flowing from manufacturing to real estate over the course of economic development? Figure 5 shows that the real estate sector uses more real estate both in terms of collateral but also real inputs, which we calculate based on data from the World Input-Output Database (Timmer et al., 2015). This is consistent with the idea that collateral constraints play a role in the shift of credit from manufacturing to real estate, as shown in Figure 1.

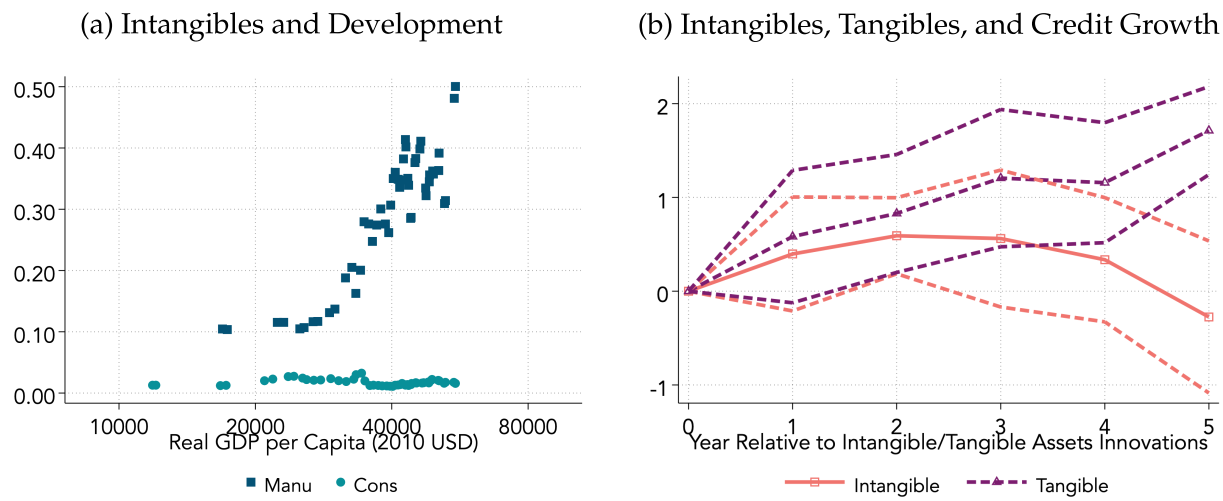
4.3.2 Intangible Assets and Sectoral Financing Constraints

A potential source of changes in collateral constraints that affect sectors differently as countries get richer may come from the rising importance of intangible assets.

Mechanis As countries develop, firms transition from asset-intensive investments in agriculture or manufacturing towards knowledge assets characterized by specialization (Ma, 2022). This leads to an increase of corporate investments into intangible capital, such as human capital, business strategy, or patents (Graham et al., 2015). Existing evidence for the United States suggests

[17] This modification relies on the fact that the level of a sector's real estate collateral share may be different across countries, but the ranking among these industries is likely very similar, as shown in Appendix Figure D.4.

Figure 6: Sectoral Asymmetry in Intangibles and Credit



Note: Panel (a) is a binscatter plot showing the relation between a sector's intangible to tangible assets and income levels. Panel (b) plots the local projection impulse response of credit to an innovation to investments in either tangible or intangible investments in a country-year-industry panel.

that an increase in intangible assets is associated with a reallocation of credit from commercial & industrial loans to real estate loans (DellAriccia et al., 2021).

Intangible assets are specific to firms, which in turn makes them harder to be redeployed and liquidated elsewhere (Hart and Moore, 1994; Shleifer and Vishny, 1992; Rampini and Viswanathan, 2013). Throughout the course of economic development, TFP growth in the manufacturing sector is stronger than that in real estate. Thus, the rising intangibility in the manufacturing sector relative to real estate may crowd out investments in easily-collateralized assets (Kermani and Ma, 2023), contributing to a slower growth rate of credit in the manufacturing sector Falato et al. (2022). This intuition is developed formally in Appendix B.4.

Evidence of Sectoral Differences in Intangible Investments over Development To validate our hypothesis, we rely on sectoral data from EU-KLEMS and INTANProd, which measure the composition of intangible and tangible assets in 27 European countries, UK, US and Japan across 16 industry aggregates dating back to 1995 (Bontadini et al., 2023). We compute the share of intangible assets in manufacturing and real estate for each country-year pair.

Figure 6a presents a striking increase in the share of intangible assets in manufacturing as countries with GDP per capita, going from 10% to 50% among the countries for which we have data. In stark contrast, the share of intangible assets is less than 5% in the real estate sector without any discernible change across income levels.

Intangible Investments and Sectoral Credit Growth To test the idea that a rising reliance on intangible assets may hurt the debt capacity of manufacturing relative to the real estate sector, we exploit differences in the growth rate of intangible and tangible assets across countries and industries over time. In particular, we estimate impulse responses using the following local projection:

$$\Delta y_{c,j,t+h} = \alpha_c^h + \nu_j^h + \sum_{l=0}^{L} \beta_{h,l}^{\text{Intang}} \Delta_1 \log\left(\text{Intang}_{c,t}\right) + \\ \sum_{l=0}^{L} \beta_{h,l}^{\text{Tang}} \Delta_1 \log\left(\text{Tang}_{c,t}\right) + \sum_{l=0}^{L} \gamma_{h,l}^{j} \Delta_1 y_{c,t-l}^{j} + \epsilon_{c,t+h}^{j}, \tag{11}$$

where Δ_h is an operator denoting the change of a variable from time t to $t+h$, α_c^h is a country fixed effect, and ν_j^h is an industry fixed effect. Panel (b) of Figure 6 plots the sequence of $(\widehat{\beta}_{h,0}^{\text{Intang}}, \widehat{\beta}_{h,0}^{\text{Tang}})$ within 5 years relative to the change of intangible/tangible asset investments. We find that a 1% increase in tangible asset investment is associated with a 1.6% increase in credit after five years. We find no statistically significant predictive power of intangible assets for future credit growth.

Our findings suggest that investments in intangible asset could be one source of a decreasing debt capacity of the manufacturing sector as countries develop. Of course, the patterns we have documented here do not allow us to establish a causal relationship. That said, our findings are consistent with existing evidence using more granular data to get at causal effects. Akcigit et al. (2018), for example, exploit variation in state-level R&D tax credits in the United States to document that they increase Research and Development (R&D) expenditure patenting, and Falato and Sim (2014) show that these R&D tax credits result in declines of bank debt and secured debt. DellAriccia et al. (2021) show that an increase in banks' exposure to intangible relative to tangible assets increases credit backed by real estate collateral. These findings support our cross-country evidence and overall suggest that the increase in less collateralizable intangible assets as countries become richer may be associated with a reallocation of credit across sectors.

4.3.3 Directed Credit Policies and Sectoral Financing Constraints

Another potential source of changes in sector-specific financing constraints is government policy. Many countries use policies that explicitly channel credit into "priority sectors." Known as directed credit, credit controls, credit ceilings, or window guidance, these policies usually aim to boost output in the manufacturing sector as part of an industrial policy strategy; in many cases, they also explicitly aim to limit lending for real estate purposes. We investigate empirically whether these policies can indeed be understood as shifters to sector-specific financing constraints.

A New Chronology of Credit Policy Liberalizations To test for the effect of directed credit policies on the allocation of credit in the economy, we construct a new chronology of credit market liberalization events for 37 countries based on narrative evidence. These policy changes cover all income groups, ranging from Nigeria to Korea and France. Appendix A provides a detailed background discussion of these policy changes, and Figure D.8 shows that there is considerable heterogeneity in the timing of these changes across countries.

Local Projection Evidence To test whether these policies matter for the sectoral composition of credit and output, we estimate local projections in a country-sector-year panel similar to Baron and Green (2023):

$$\Delta_h y_{c,s,t+h} = \alpha_c^h + \gamma_t^h + \sum_{j \in \{\text{Manu.,Cons.}\}} \beta_j^h \text{Liberalization}_{c,t} \times \mathbf{1}\{s = j\} + \sum_{l=0}^{L} \gamma_l \Delta_1 y_{c,s,t-l} + \epsilon_{c,s,t+h}, \tag{12}$$

for $h = 1, \ldots, H$, where the dependent variable is the change of sector-specific variable from t to $t + h$ in country c sector j, α_c^h is the country fixed effect, $\text{Liberalization}_{c,t}$ is an indicator for credit policy liberalization in country c year t, $\mathbf{1}\{s = j\}$ is an sector indicator, for example, $\mathbf{1}\{s = \text{Manu}\}$ takes 1 if the sector is manufacturing.

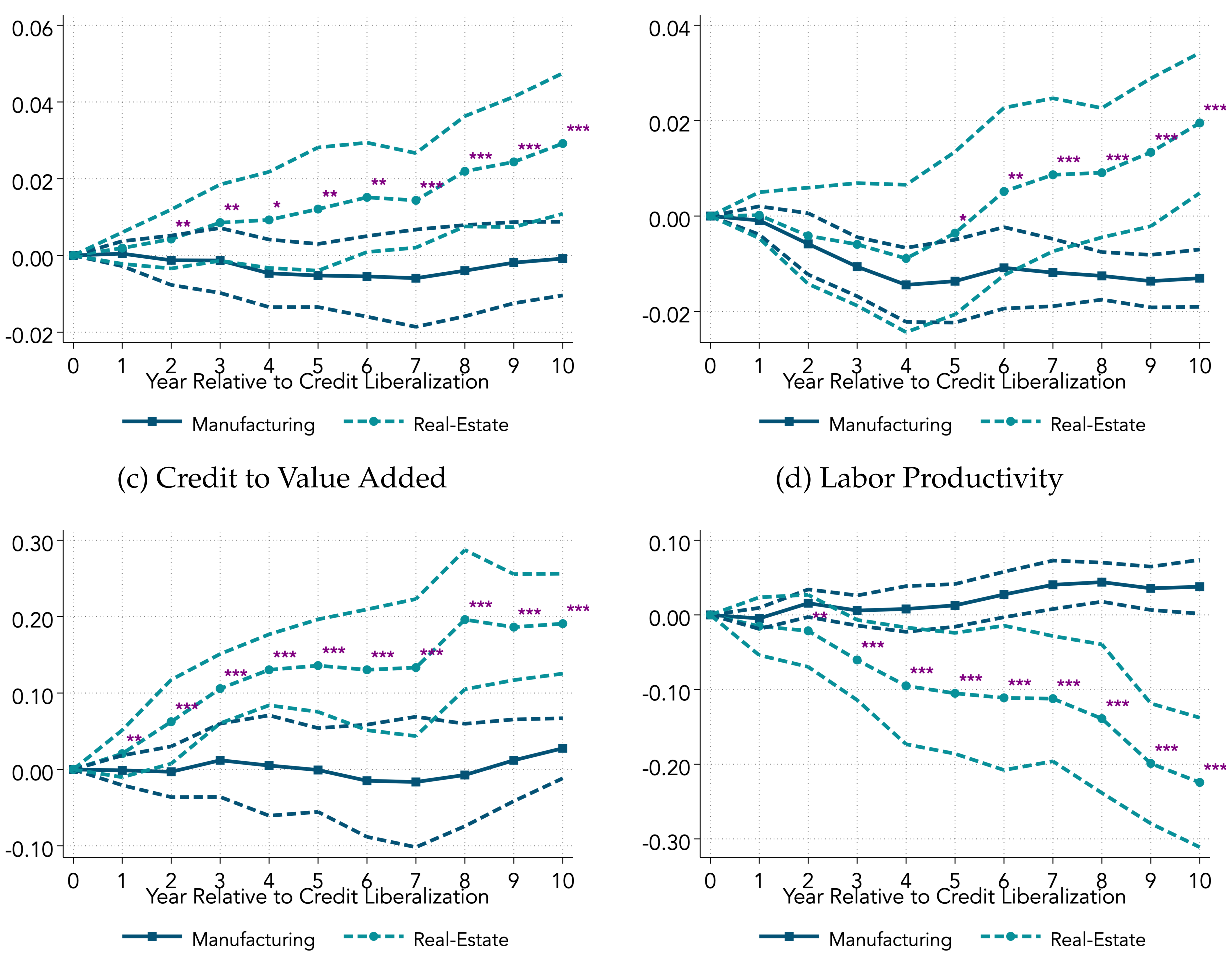
Figure 7: Local Projection: Credit Liberalization

(a) Credit to GDP

(b) Value Added to GDP

(c) Credit to Value Added

(d) Labor Productivity



Note: This figure presents local projection impulse responses of aggregate and sectoral variables following directed credit policy liberalization as in (12). The dashed lines represent 95% confidence intervals from standard errors computed using Driscoll and Kraay (1998).

Figure 7 depicts the path of $\{\widehat{\beta}^h_{\text{Manu.}}, \widehat{\beta}^h_{\text{Cons.}}\}_{h=0}^{10}$ for different dependent variables. Figure 7a shows that, after a directed credit liberalization, the ratio of real estate credit to GDP increases significantly up to $h = 10$. By contrast, there is no change in manufacturing credit to GDP ratio. From the real economy side, Figure 7b indicates that output shifts from manufacturing to the real estate after the liberalization. As indicated in Figure 7c, the credit to value added ratio soars in the real estate sector, which supports our hypothesis that directed credit policies can be thought of as a shifter for the financial constraint of the real estate sector.

A possible concern regarding the interpretation of these results is that the liberalization of directed credit may boost sectoral TFP and as such lead to changes in intangible investments, for which we already outline correlational evidence above. In Figure 7d, we plot the dynamics of labor productivity following the liberalization of directed credit policies. We find a relatively small change of manufacturing labor productivity and a large drop of that in the real estate sector. These results support the idea that the TFP-enhancing channel is at least not a major force in our setting.

5 Quantitative Exercise

In this section, we calibrate our model to match the data in Section 5.1 and decompose the impact of sectoral TFP and financial constraints on the real economy and credit market structural change in Section 5.2.

5.1 Calibration

To calibrate the model, we add two additional features relative to the baseline model. First, we add labor as a production input, with the sectoral specific labor share ν^j, satisfying $\alpha^j + \nu^j < 1$. Savers provide 1 unit of labor inelastically at the equilibrium wage w. Second, we model residential housing as an investment instead of a service flow, with a depreciation rate δ_h. Appendix C elaborates on the set up of this extended model, specifies equilibrium conditions following these modifications, and derives the decomposition of credit and nominal output ratios.

To quantify our model, we assume economies with different income levels are at their own steady states, determined by the exogenous parameters. For each economies, we calibrate the following parameters

$$\Omega = \{z^j, \alpha^j, \nu^j, \lambda^j, \chi^j\}_{j\in\{M,E\}} \cup \{\beta, \eta, s, \delta, \delta_h\}$$

We further assume *only* $\{z^j, \lambda^j, \chi^j\}_{j\in\{M,E\}}$ are different across economies, and all other parameters are identical across economies.

Externally Assigned Parameters We calibrate $\beta^s = 0.98$ to match the long run real interest rate $r = 2\%$, between the real return of bills and bonds (Jordà et al., 2019). Close to Buera and Shin (2013), δ_h and δ are set to 0.05. We set $\beta = 0.95$. From the production side, we set the real estate input shares to be $\alpha^M = 0.017$ and $\alpha^E = 0.240$, and impose an equal labor share across sectors $\nu \equiv \nu^j = 2/3$.

Internally Calibrated Parameters Our selection of moments for internal calibration is in line with the baseline model's prediction and comparative statics. From Proposition 2, the elasticity of substitution η is closely related to sectoral relative output $qy^E/(y^M + qy^E)$ due to structural change in the real economy. Proposition 1 states that an increase of s, ceteris paribus, drives up the housing price, which motivates us to pick s matching variation of housing price index with respect to logged real GDP per capita in Figure 3. Meanwhile, Proposition 3 suggests that the sectoral credit to value added ratio κ^j and mortgage share ω^j are crucial to calibrate the financial constraint parameters. In Appendix Proposition B.4, we strengthen this argument, showing these two moments can uniquely identify λ^j and χ^j as in David and Venkateswaran (2019). Lastly, by normalizing real estate sector TFP to 1, we calibrate manufacturing TFP z^M to match the sectoral labor productivity difference of these two sectors, i.e. $\log(y^M/n^M) - \log(y^E/n^E)$.

We group the country-year data into $N = 20$ groups based on real GDP per capita. We run a regression of the key data moments on dummies for these income groups, controlling year and country fixed effects to focus on the variation coming from economic development. The former one filters out year-specific common shocks that impact all economies, in line with our focus on the steady state equilibrium, while the latter one filter out country-specific characteristics not captured by our simple model. The empirical house price index is normalized by a manufacturing price index, computed as the ratio of nominal to constant-price value added. The purpose of this normalization is to match our model, where the collateral price is relative to the manufacturing good's price, which is standardized to be 1.[18]

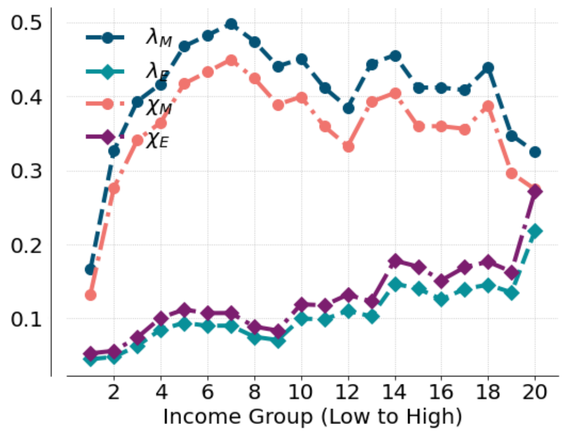
Our two-step calibration strategy is as follows. First, given a pair of (η, s), we find a sequence of $\{z_n^M\}_{n=1}^N$ to minimize the distance between sectoral labor productivity differentials in the model and data. Second, we find a pair of (η, s) to target the nominal output share and relative house price in all income bins. Figure 8 reports the value of the calibrated parameters. Figure 8a shows both the asset-based and cash-flow based borrowing constraints looser in the manufacturing sector, due to the low value of α^M. We also see the financial constraints in manufacturing sector are loosened more at the early stage of development and remain relatively constant afterwards. By contrast, the financial constraints of the real estate sector become increasingly looser over the course of development. Specifically, λ^E in the richest countries is 4.8 times of that in the poorest, while λ^M is 1.9 times of that in the poorest. Figure 8b shows that the manufacturing sector's TFP z^M increases considerably as countries get richer, with an approximately six-fold increase when comparing the least-developed to the most-developed countries. The internally calibrated $s = 2.5$ and $\eta = 0.72$, the latter one close to the estimation result of 0.85 in Herrendorf et al. (2013).

Our model closely match our key empirical findings about structural transformation in the

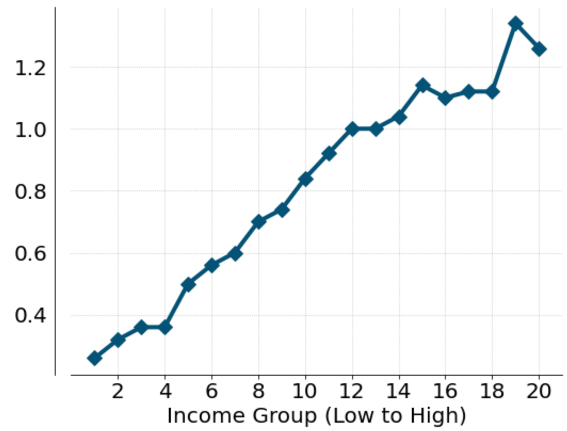
[18]Because the relative house price index is only comparable within a country, we only control for country fixed effects. We discard the estimates for the first 3 income bins since they contains at most 7 observations, relative to more than 20 observations in other bins.

Figure 8: Calibrated Parameters of the Model

(a) Sectoral Financial Constraint $\{\lambda_n^j, \chi_n^j\}_{n=1}^N$



(b) Sectoral TFP $\{z_n^M\}_{n=1}^N$



Note: These figure plot the key parameters governing sectoral financial constraints and TFP in the quantitative version of our model.

credit market and in the real economy: a salient rise of the share of real estate credit in Figure 9a, and the smaller increase of the real estate sector's nominal output share in Figure 9b. The increase of the (relative) house price and labor productivity in the manufacturing sector is also congruent with the empirical moments, consistent with the mechanism highlighted in the literature on supply-side structural transformation (Ngai and Pissarides, 2007).

5.2 Unpacking Structural Transformation: Finance vs. Real Economy

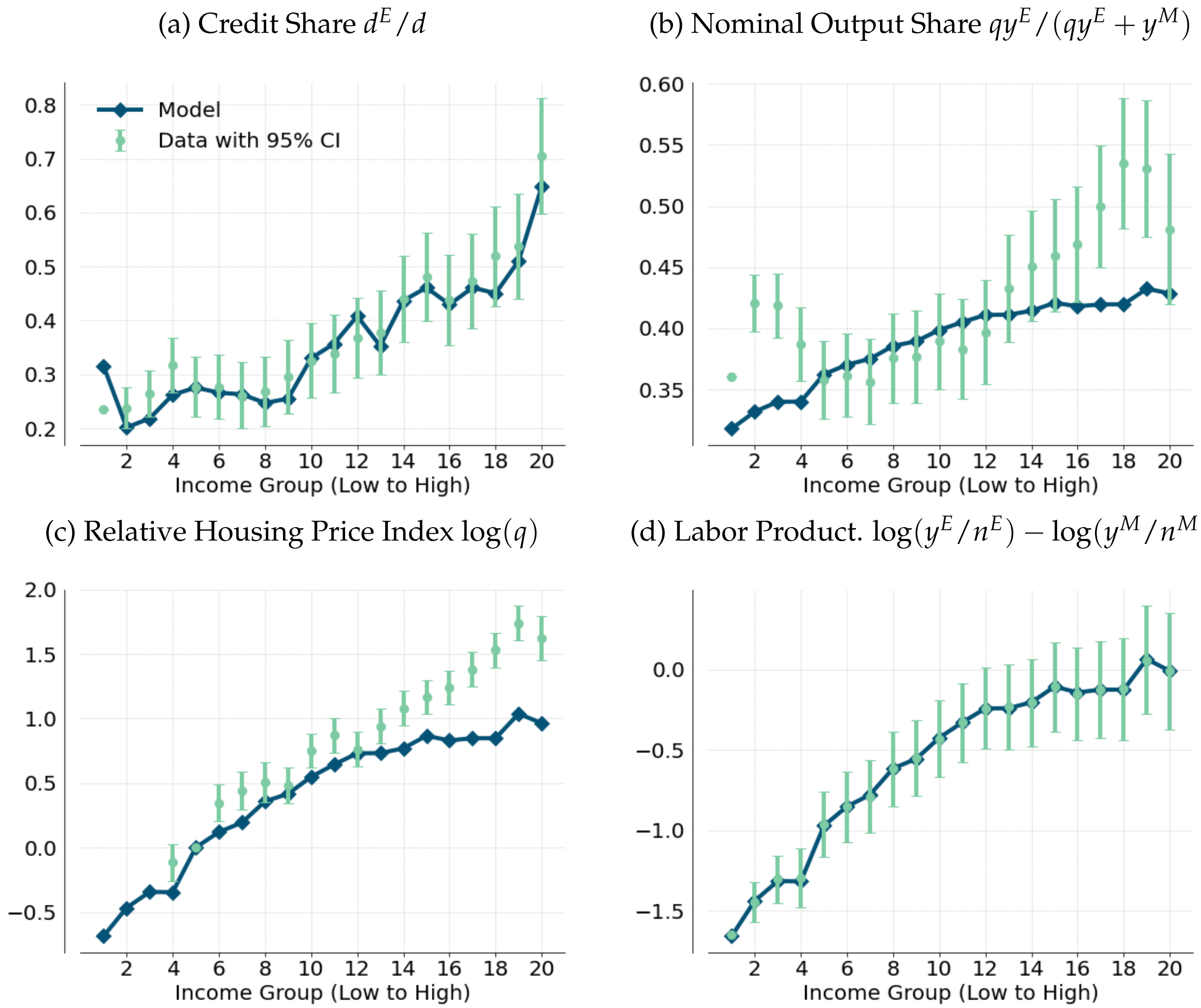
Equipped with our quantitative model, we conduct a development accounting analysis as in Caselli (2005). Our goal is to pin down how differences in sectoral TFP and financial constraints between the poorest and the richest countries may account for the share of different sectors in credit and output.

Quantitative Decomposition We start by quantifying each component within the decomposition rule in Equation (6). In Figure 10, we shut down each channel one-by-one holding all other channels constant as in our baseline model. We plot the corresponding counterfactual credit and output shares. By comparing the difference between the counterfactual scenario and the baseline results, we know how each channel contributes to structural transformation in credit and the real economy.

To begin, if there were no changes in the price of collateral (**Q**), the share of the real estate sector in both credit and output would have *decreased* over the course of development. This collateral price channel is quantitatively important but counterbalanced by the relative productivity (**Z**) and wage (**W**) channels, which are associated with a higher share of the real estate sector in credit and output.[19] Comparing the baseline model with the counterfactual shutting down **Z** confirms our

[19]Note that the wage channel **W** only appears due to our modification of the baseline model.

Figure 9: Targeted Moments of the Model



Note: This figure shows the comparison of moments from data and quantitative model, following the calibration procedure in Section 5.1. The navy-blue vertical bars with dots show the point estimates of empirical moments with 96% confidence interval. The light-colored blue solid line represents the targeted moments from the model.

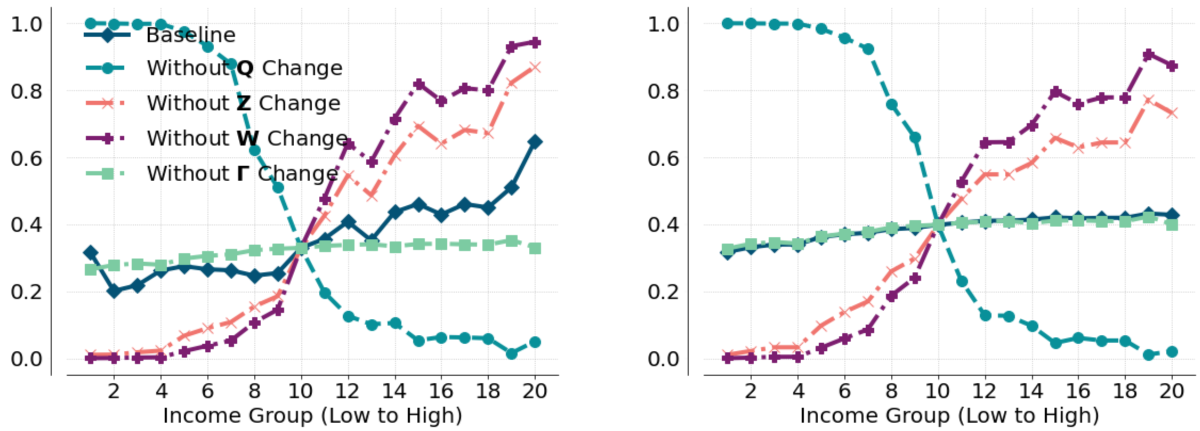
intuition that productivity growth in the manufacturing sector stimulates the use of collateral in the real estate sector by increasing its price. The overall effect of changing the price of collateral (**Q**), relative productivity (**Z**), and wages (**W**) is exactly the same as only turning off the role of collateral constraints (**Γ**). From Figure 10a, we can see that, without a change in $\mathbf{\Gamma}_d$, there is much less variation in the share of credit going to the real estate sector than what we observe in the data. In contrast, Figure 10b shows that changes in $\mathbf{\Gamma}_y$ make little difference for the share of the real estate sector in output. In Appendix Table E.13, we show that collateral constraints account for 77.4% and 34.1% of the cross-country variation in relative credit and output shares, respectively.[20]

Development Accounting Analysis Recall from Proposition 2 that both forces coming from the real economy (e.g., sectoral TFP) and those from the financial sector (characterized by the

[20]By taking logs of our decomposition rule, we can, for example, write the logged credit ratio as the sum of these channels in logs. By taking the logged difference of each channel, we can back out the contribution for each channel. This additive separable nature guarantees the total contribution sums up to 100%

Figure 10: Quantifying the Decomposition Rule

(a) Credit Share d^E/d (b) Nominal Output Share $qy^E/(qy^E + y^M)$



Note: These figures plot the counterfactual credit share d^E/d and nominal output share $qy^E/(qy^E + y^M)$ by income groups when shutting down the relative productivity channel $\mathbf{Z}$, collateral price channel $\mathbf{Q}$, collateral constraints channel $\mathbf{\Gamma}$, and wage channel $\mathbf{W}$ separately, and hold all other channels constant. The difference between the counterfactual and baseline results represents the contribution of the corresponding channel.

collateral constraints parameter) can lead to structural change. Our final goal is to understand the magnitude of these two forces through a development accounting analysis in a similar fashion to Caselli (2005).

Table 2 shows that this exercise reveals an interesting disconnect between finance and the real economy. In the first row, we only vary the degree of financial constraints while holding sectoral TFP constant, while the second row only varies sectoral TFP. This shows that, an loosening of financing constraints, characterized by increasing λ^j and χ^j, explains approximately 70% of structural change (the "Financial Kuznets Facts"). The remaining 30% come from growth in the manufacturing sector's TFP. By contrast, financial constraints account only for 1% of structural change in the real economy, which is driven almost entirely by changes in z^M.[21]

To better understand this disconnect between credit and output, we revisit the two roles the financial constraint parameters have in a sector's share in output. First, over economic development, financial constraints in the real estate sectors are relaxed more than those in manufacturing. The real estate sector also enjoys a higher collateral input share. These two effects lead to a larger change in Γ_y^E relative to Γ_y^M. From a partial equilibrium perspective, this change in collateral constraints explains 34% of the variation in the output share across income groups. Second, as indicated by Proposition 1, a higher λ^M and χ^M push up the price of collateral, holding everything else fixed. However, since the financial constraints are loosened much more in the real estate relative to manufacturing sector, there is a downward pressure on the price of collateraldue to the increasing *supply* of collateral. Taken together, the price of collateral would have decreased throughout economic development, as indicated in Table 2, if only financial forces were

[21]The numbers in each column of Table 2 do not necessarily sum up to 100% due to the potential interaction between financial and economic forces, but the sum of these numbers is close to 100%.

Table 2: Development Accounting Analysis

	$d^E/(d^E+d^M)$			$qy^E/(qy^E+y^M)$			q		
	5 to 15	1 to 20	1 to 7	5 to 15	1 to 20	1 to 7	5 to 15	1 to 20	1 to 7
Only Varying λ^j and χ^j	70.8	67.7	212.4	0.3	1.6	2.3	-0.7	-1.4	-0.4
Only Varying z^M	28.8	29.7	-94.4	99.7	98.3	97.6	100.8	101.8	100.0

Note: This table shows how financial constraints and sectoral TFP contribute to structural transformation in credit and output as measured by the following variables: the real estate credit share $d^E/(d^E+d^M)$, the real estate output share $qy^E/(qy^E+y^M)$, and the price of collateral q. In row 1, we only vary sectoral financial constraints as governed by λ^j and χ^j. In row 2, we only vary the TFP of the manufacturing sector. For each variable, we compute their counterfactual value when only one channel is active, by income group. We denote the difference between some group range (for example, 5 to 15) as $\Delta_{\text{Counterfactual}}$. We calculate the difference of same variable in the quantitative model between same group range, denoted by $\Delta_{Baseline}$. We report in the table, $\Delta_{\text{Counterfactual}}/\Delta_{Baseline} \times 100$ as the contribution of a specific channel to the cross-country variation for a certain variable.

present. Put differently, the positive partial equilibrium effect of looser financing constraints are largely offset by the general equilibrium effect of a higher price of collateral, which explains the small contribution of changing λ^j and χ^j on the output share of the real estate sector. Turning to structural changes in the credit market, there is an additional debt capacity effect that increases the amount of credit per unit of nominal output, which plays a significant role. By contrast, the variation in the price of collateral comes almost entirely from the change of manufacturing TFP; productivity thus explains almost all of structural transformation in the real economy.

The disconnect between structural transformation in credit relative to the real economy thus stems from the fact that productivity growth is the main driving force for the price of collateral price as countries become richer. This result is similar to Kiyotaki et al. (2011), who argue that relaxing collateral constraints can play a limited role due to the conversion from rented to owned units. In our model, the takeaway is similar but operates differently. First, as shown in Figure 8, the variation in λ^j and χ^j is much smaller than the change of z^M. Second, from Equation B.5 and the production function, holding all else fixed, 1 percent increase of z^M leads to $\frac{1}{1-\alpha^M}$ percent increase of manufacturing output y^M. But a 1 percent increase in $\widetilde{\lambda}^j\widetilde{\chi}^j$ only results in $\frac{\alpha^M}{1-\alpha^M}$ percent increase of y^M. Taken together, this reconciles the relatively minor importance of collateral constraints compared with the relative productivity channel, and it also explains the limited role of variation in the price of collateral.

Additional Results and Robustness Checks By shutting down the sectoral heterogeneity in collateral input and financial constraints sequentially, we find that sectoral heterogeneity is crucial to jointly match structural change in credit and output over development, as shown in Appendix Figure D.10. We also study an extended version of our baseline model that only has asset-based constraints and adds capital as an additional tangible assets. Our main takeaways from the development accounting analysis are unchanged.

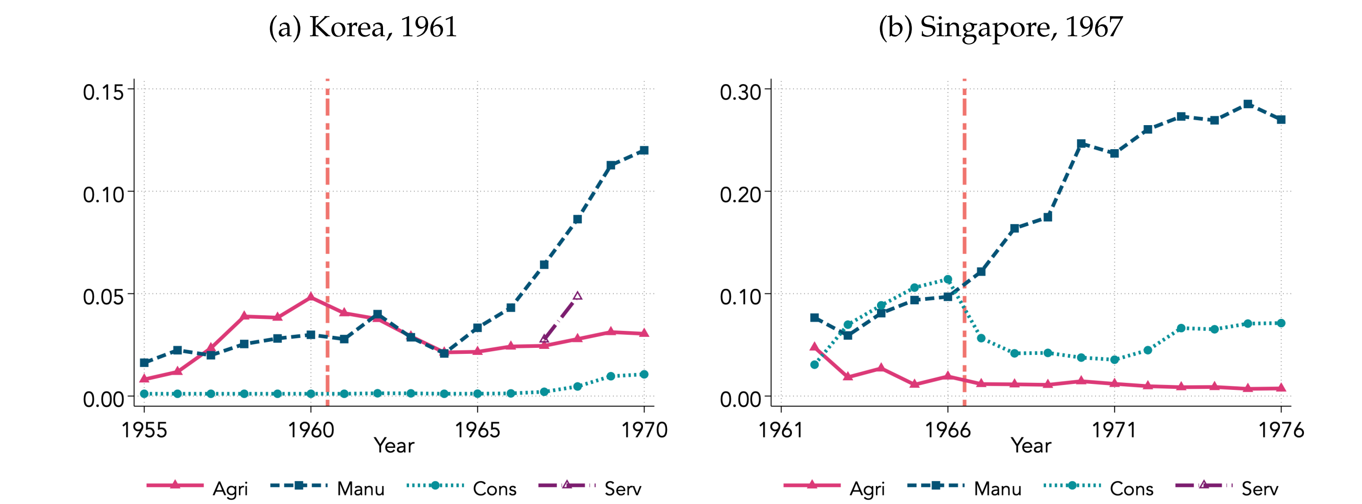
6 Some Suggestive Evidence on Credit Allocation and Growth

In this section, we are interested in the link between the sectoral distribution of credit in the economy and economic growth. We first document a surge in credit to the manufacturing sector after major policy reforms at the beginning of the East Asian growth miracles. As we show, these phenomenal growth episodes were not accompanied by changes in credit to other sectors. Then, we show that a higher share of credit to manufacturing is correlated with higher economic growth in the long run in our cross-country panel data. On the contrary, a higher real estate credit share is negatively related with growth.

6.1 Case Studies: East Asian Growth Miracles

Many East Asian economies experienced spectacular and sustainable growth for decades following major economic reforms. Buera and Shin (2013) document a surge in TFP and GDP per worker during these growth miracles, accompanied by financial deepening, as measured by the ratio of private credit-to-GDP. Itskhoki and Moll (2019) compile historical accounts of development policies for fast-growing East Asian economies. Six out of seven subsidized credit, and five of them also subsidized intermediate inputs. The granular nature of our data allows us to dissect the aggregate increase in credit documented by Buera and Shin (2013) into credit to different sectors.

Figure 11: Credit Allocation During East Asian Growth Miracles



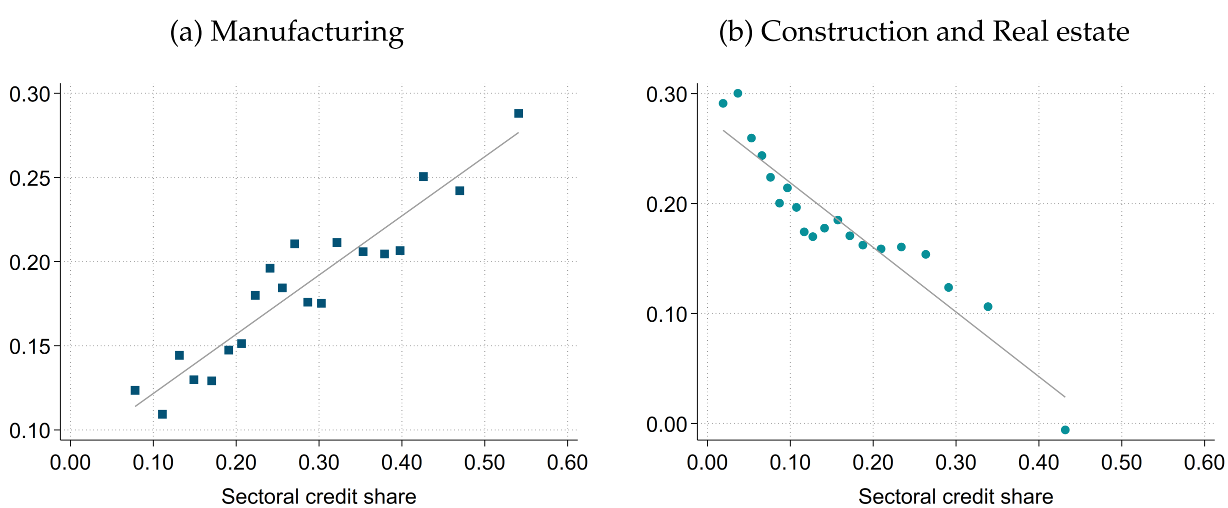
Note: These figures show the sectoral credit-to-GDP ratio for different sectors during the period of the East Asian growth miracles Korea and Singapore. The timing for economic reforms comes from Buera and Shin (2013), and we mark reforms with a vertical line in the figure.

Figure 11 provides two case studies to understand the sectoral allocation of credit before two periods of economic reforms that were later followed by rapid growth: Korea in 1961 and Singapore in 1967. During both episodes, these reforms were followed by a large uptick in lending to the manufacturing sector, but not other sectors. In Appendix Figure D.7, we further show sectoral credit dynamics for other episodes. Except for Thailand, where we observe credit growth in almost all sectors, this evidence points to the conclusion that credit expansion in manufacturing at the earlier stages of development has been associated with growth accelerations.

6.2 Systematic Evidence: Cross-Country Reduced Form Evidence

Given the stylized facts and our model, we would like to investigate whether the allocation of credit across sectors–in particular when credit flows from the manufacturing to the real estate sector–may be a contributing factor in explaining a country's future growth trajectory. The principal challenge is that we have no reason to believe the share of credit flowing to different sectors is exogenous. With this limitation in mind, it is still interesting to examine whether there is a correlation between the allocation of credit and future economic growth to get a sense of the potential relevance of the mechanism of our model.

Figure 12: The Allocation of Credit and Long-Run Growth



Note: These figure visualize the correlation of the share of credit going to manufacturing and the real estate sector with future economic growth. The horizontal axis represents the sectoral credit share at time t, and the vertical axis represents the log-difference of real GDP per capita from t to $t+5$.

Our basic objective with this somewhat more systematic investigation is to relate a country's share of outstanding credit in different sectors to changes in the natural logarithm of real GDP over some future time horizon. Figure 12 shows a binscatter plot visualizing the relationship between the share of the manufacturing and real estate sectors in total non-financial firm credit and future economic growth. A higher share of credit going to manufacturing is associated with stronger future growth in real GDP per capita over the next five years. Conversely, a higher credit share to real estate is correlated with a lower growth rate.

In addition to the issue of causality, this exercise faces two additional challenges without the addition of control variables. First, richer countries have a lower share of manufacturing in outstanding credit, as shown in Figure 1. As such, we would want to condition on a country's initial level of income. Second, there may be a concern that changes in a sector's share in output–independent of credit–may be linked to future GDP (Caselli, 2005).

To address these concerns, we also consider a specification where we include logged real GDP per capita and the share of each sector in total value added at time t as control variables. We also present results where we add year and/or country fixed effects, and also tried to look at future growth over ten instead of five years. In all of these specifications, we find the same baseline finding, which we report in Appendix Table E.5.

In sum, there appears to be a reasonably strong correlation between the share of credit to different sectors and economic growth. This evidence can be interpreted as complementary to the finding in Müller and Verner (Forthcoming) that lending to the non-tradable sector predicts recessions at business cycle frequency, while credit to the tradable sector is linked with higher productivity growth. As outlined above, nothing in our analysis by itself allows us to say anything about causation. Our empirical results should thus best be interpreted as suggestive patterns, which we hope will motivate future tests into how financial factors may contribute to shaping a country's economic growth by affecting the process of structural transformation.

7 Conclusion

This paper documents new patterns about the role of finance in structural transformation. These "financial Kuznets facts" show a salient reallocation of credit from manufacturing to real estate over the course of long-run economic development that is considerably more pronounced than structural changes in the real economy. To rationalize these patterns, we build a simple two-sector model that integrates sector-specific collateral constraints into an otherwise standard model of structural transformation. In our model, the higher TFP growth rate of manufacturing relative to the real estate sector leads to a rise in house prices. Because the real estate sector relies more on housing both as an input for production but also as collateral to borrow, an increase in house prices causes a reallocation of credit away from the manufacturing sector. As we show, one source of a reallocation towards real estate could be a lower debt capacity of manufacturing stemming from an increasing reliance on intangible assets or changes in sector-specific credit policies.

We use a calibrated version of our model as a laboratory to study how both financial and "real" economic forces contribute to structural transformation in credit and output. Our counterfactual experiments suggest that structural transformation in the real economy stems almost entirely from the disparity in sectoral TFP growth rates between manufacturing and real estate. In contrast, the allocation of credit is primarily driven by changes in the slackness of collateral constraints. Because long-run growth is positively correlated with the share of credit flowing to manufacturing, and negatively with the share to the real estate sector, these results raise important policy questions.

Some caveats are in order. First, a clear limitation of our model is that it does not directly consider how an exogenous change in the allocation of credit may affect economic growth. While our empirical evidence can only be interpreted as suggestive, the possibility of such an effect would be important to study in future work. Second, we abstract from how exactly financial institutions operate. In our model, we focus on sectoral heterogeneity on the borrower side, and credit is directly provided by savers. In reality, the regulation and ownership of banks may play an important role in determining the allocation of credit. Third, our study only examines the allocation of credit in a cross-country setting. Studying structural changes in credit in one specific economy may open the door to establish a causal link between finance and structural changes in the real economy. We leave these promising avenues for exploration in future research.

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A Credit Market Liberalization

B Proof, Derivation, and Extensions of Model

Section B.1 shows proof and derivation in for the benchmark model in Section 3 and further provides four auxiliary results. Section B.4 provides an extended model with intangible assets. It takes the rise in asset intangibility in the manufacturing sector as given and show how it translates into a relative slower increase in credit to output ratio in manufacturing relative to real estate, a channel tested in Section 4.3.3. Section B.5 shows that our main result is robust under the non-homothetic preference with a mild assumption.

B.1 Proof for Propositions in the Benchmark Model

In this section, we prove the main result in our benchmark model in Section 3.

B.1.1 Equilibrium Conditions

Savers The Lagrangian of the optimization problem for saver is

$$\mathcal{L}^i = \sum_{t=0}^{\infty} (\beta^S)^t \left\{ v(c_t^S, h_t^S) + \phi_t^S \left[b_t - c_t^S - q_t h_t^S - \frac{b_{t+1}}{1+r_t} \right] \right\},$$

where ϕ_t^j is the Lagrangian multiplier for the flow of fund constraint for savers, $v(c,h)$ is the instantaneous utility function with elasticity of substitution η. The FOCs with respect to c_t^S, h_t^S are

$$v_c(c_t^S, h_t^S) = \phi_t^S, \quad v_h(c_t^S, h_t^S) = \phi_t^S q_t, \quad \Rightarrow \frac{c_t^S}{h_t^S} = \left[\frac{q}{s}\right]^\eta \tag{B.1}$$

Equation (B.5) is intuitive: the left-hand side captures the marginal benefit of increasing one unit of collateral for period $t+1$: she gains the discounted marginal production of collateral in the next period (the first term) and benefits from the marginal value of slackening the collateral constraint for higher debt capacity (the second term). The right-hand side captures the marginal cost of that since the investment of collateral for tomorrow suppresses income today, and reducing consumption today (the first term) in exchange for that tomorrow (the second term).

For savers, the optimal savings, analogous to the Euler equation for the consumption-saving problem, is expressed as

$$\beta^S \phi_{t+1}^S - \frac{1}{1+r_t} \phi_t^S = 0 \tag{B.2}$$

Entrepreneurs Setting up the Lagrangian of the optimization problem for entrepreneur in sector j, we have

$$\mathcal{L}^j = \sum_{t=0}^{\infty} \beta^t \Big\{ v(c_t^j, h_t^j) + \phi_t^j \Big[p_t^j z_t^j (l_t^j)^{\alpha^j} + \frac{d_{t+1}^j}{1+r_t} - c_t^j - q_t h_t^j - q_t \left[l_{t+1}^j - (1-\delta) l_t^j \right] - d_t^j \Big]$$
$$+ \theta_t^{\lambda^j} (\lambda_t^j q_{t+1} l_{t+1}^j - d_{t+1}^{\lambda^j}) + \theta_t^{\chi^j} (\chi_t^j p_t^j z_t^j (l_t^j)^{\alpha^j} - d_{t+1}^{\chi^j}) \Big\}, \tag{B.3}$$

where ϕ_t^j, $\theta_t^{\lambda^j}$ and $\theta_t^{\chi^j}$ are the non-negative Lagrangian multiplier for the flow of fund constraint (2) and the financial constraints (3). The FOCs for $d_{t+1}^{\lambda^j}$ and $d_{t+1}^{\chi^j}$ are

$$\frac{\phi_t^j}{1+r_t} - \beta \phi_{t+1}^j - \theta_t^{\lambda^j} = 0, \quad \frac{\phi_t^j}{1+r_t} - \beta \phi_{t+1}^j - \theta_t^{\chi^j} = 0 \tag{B.4}$$

with their complementary slackness conditions. One can notice that $\theta_t^{\lambda^j} = \theta_t^{\chi^j} \equiv \theta_t$. Intuitively, the asset-based and cash flow-based borrowing are fungible for entrepreneur, which shares the same shadow price.

The FOC for collateral usage l_t^j is written as

$$\alpha^j \beta \phi_{t+1}^j p_{t+1}^j z_{t+1}^j (l_{t+1}^j)^{\alpha^j - 1} + \theta_t^j \lambda_t^j q_{t+1} + \theta_{t+1}^j \alpha^j \beta \chi_t^j p_{t+1}^j z_{t+1}^j (l_{t+1}^j)^{\alpha^j - 1} = \phi_t^j q_t - \beta(1-\delta) \phi_{t+1}^j q_{t+1}. \tag{B.5}$$

Equation (B.5) is intuitive: the left-hand side captures the marginal benefit of increasing one unit of collateral for period $t+1$: she gains the discounted marginal production of collateral in the next period (the first term) and benefits from the marginal value of slackening the collateral constraint for higher debt capacity (the second term). The right-hand side captures the marginal cost of that since the investment of collateral for tomorrow suppresses income today, and reducing consumption today (the first term) in exchange for that tomorrow (the second term).

The consumption side is the similar as the savers, by changing the index from S to j in Equation B.1.

B.1.2 Steady States Equilibrium

Credit-Constrained Economy Combining Equations (B.2) and (B.4), we have, at the steady states

$$\theta^j = \phi^j \left(\frac{1}{1+r} - \beta \right) = \phi^j \left(\beta^S - \beta \right) > 0, \text{ and } d^j = \lambda^j q l^j + \chi^j p^j y^j \tag{B.6}$$

The financial constraints are binding for each sectors. Intuitively, the savers are more patient $\beta^S > \beta$, who provides the debt elastically with price $\beta^S / \beta - 1$.

Consumption Side Aggregation Aggregating Equation B.1 over i, we obtain the relation between aggregate manufacturing goods $c = \sum_i c^i$ and residential housing $h = \sum_i h^i$,

$$\frac{c^i}{h^i} = \left[\frac{q}{s}\right]^{\eta} \Rightarrow \frac{c}{h} = \left[\frac{q}{s}\right]^{\eta}, \tag{B.7}$$

Equation B.7 implies that the higher the collateral price q is, the lower the relative demand for residential housing h/c is. The elasticity of relative expenditure qh/c to collateral price q is $1-\eta$. When the elasticity of substitution η is less than one, a one percent increment implies less than a one percent increment of relative expenditure. Conversely, when η is greater than one, an increase in collateral price leads to a decline in relative expenditure in residential housing because the price effect dominates.

Market Clearing Conditions To obtain the optimal amount of collateral for each sector at the steady state, we combine two equations from the firm collateral inputs (B.5) and (B.4), we have Equation B.5 in Section 3.2.

The market clearing conditions at the steady state are written as

$$z^M (l^M)^{\alpha^M} = c, \quad z^E (l^E)^{\alpha^E} - \delta l^E = h + \delta l^M \tag{B.8}$$

Combining Equations (B.7) and (B.8), we have

$$h = (s/q)^{\eta} c = (s/q)^{\eta} z^M (l^M)^{\alpha^M} = \underbrace{(s/q)^{\eta} z^M (\widetilde{\zeta}^M)^{\alpha^M}}_{\widetilde{\zeta}^H} q^{-\frac{\alpha^M}{1-\alpha^M}},$$

which decreases with q. We obtain Equation (7) in Section 3.2 by substituting $h(q)$ and $l^M(q)$ into the market clearing condition for real estate good. Notice that when $q \to 0$, the right-hand side of Equation (7) approaches to ∞ and when $q \to \infty$, it approaches to 0. There exists a unique collateral price q clears the market.

To ensure the steady state equilibrium is well-defined, we assume that collateral usage for each sector $l^j > 0$, and the net output of real estate sector, $z^E (l^E)^{\alpha^E} - \delta l^E$ is positive by imposing the following assumption,

Assumption B.1 (Parameters Restriction for Asset-Based Financial Constraint)**.** *The parameters for asset-based financial constraints λ^j are restricted below $\lambda^j_{\max}$, for $j \in \{M, E\}$, where*

$$\lambda^M_{\max} \equiv \frac{1 - \beta(1-\delta)}{\beta^S - \beta}, \quad \lambda^E_{\max} \equiv \frac{1 - \beta(1 - \delta - \alpha^E \delta)}{\beta^S - \beta}$$

The following proposition defines the steady state equilibrium.

Proposition B.1 (Steady State Equilibrium)**.** *Under Assumption B.1, there exists a unique steady-state equilibrium, consisting of (aggregate) allocations (c, h, l^j, d^j) and prices and shadow prices (r, q, ϕ^i, θ^j), such that,*

1. *the optimization problem for each agents is solved by Equations* (B.7), (B.6), (B.6), (4)*;*
2. *market clearing conditions* (B.8) *hold;*
3. *all endogenous variables are constant over time.*

B.1.3 Proof of Proposition 1

1. With $\widetilde{\lambda}^j$ increasing with λ^j, it is easy to obtain

$$\frac{\partial \widetilde{\zeta}^j}{\partial z^j} > 0, \quad \frac{\partial \widetilde{\zeta}^j}{\partial \lambda^j} > 0, \quad \frac{\partial \widetilde{\zeta}^H}{\partial z^M} > 0, \quad \frac{\partial \widetilde{\zeta}^H}{\partial \lambda^M} > 0$$

And thus, increasing z^M or λ^M increases the right hand side of Equation (7), shifting the demand curve to the right, while it does not affect the left-hand side of it, which implies q should go up. Lastly, an increase in s only increases the right hand side of Equation (7), holding all else equal. To make the equation balance, q should increase.

2. The proof for elasticity ε_{q,z^M} is intuitive. First, we can rewrite the Equation (7) as

$$z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E = (\widetilde{\vartheta}^H q^{1-\eta} + \widetilde{\vartheta}^M)(z^M/q)^{\frac{1}{1-\alpha^M}} \tag{B.9}$$

where $\widetilde{\vartheta}^H = s^\eta(\alpha^M\widetilde{\lambda}^M\widetilde{\chi}^M)^{\frac{\alpha^M}{1-\alpha^M}}, \widetilde{\vartheta}^M = \delta(\alpha^M\widetilde{\lambda}^M\widetilde{\chi}^M)^{\frac{1}{1-\alpha^M}}$. With the simple case that $\eta = 1$, one can write

$$\frac{z^M}{q} = \left[\frac{z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E}{\widetilde{\vartheta}^H + \widetilde{\vartheta}^M}\right]^{1-\alpha^M} \tag{B.10}$$

where the right hand side is invariant with either z^M or q. Thus, the elasticity $\varepsilon_{q,z^M} = 1$.

For other case when $\eta \neq 1$, we prove by using implicit function theorem. We construct the following function of q and z^M from Equation (B.9),

$$F(q, z^M) = z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E - \left(\widetilde{\vartheta}^H q^{-\eta-\frac{\alpha^M}{1-\alpha^M}} + \widetilde{\vartheta}^M q^{-\frac{1}{1-\alpha^M}}\right)\left(z^M\right)^{\frac{1}{1-\alpha^M}}$$

Our first goal is to compute $\frac{\partial q}{\partial z^M}$, Notice that

$$\frac{\partial F(q,z^M)}{\partial q} = \left(z^M\right)^{\frac{1}{1-\alpha^M}}\left[\left(\eta + \frac{\alpha^M}{1-\alpha^M}\right)\widetilde{\vartheta}^H q^{-\eta-\frac{\alpha^M}{1-\alpha^M}-1} + \left(\frac{1}{1-\alpha^M}\right)\widetilde{\vartheta}^M q^{-\frac{1}{1-\alpha^M}-1}\right] \tag{B.11}$$

$$\frac{\partial F(q,z^M)}{\partial z^M} = \frac{1}{1-\alpha^M}\left(z^M\right)^{\frac{1}{1-\alpha^M}-1}\left(\widetilde{\vartheta}^H q^{-\eta-\frac{\alpha^M}{1-\alpha^M}} + \widetilde{\vartheta}^M q^{-\frac{1}{1-\alpha^M}}\right) \tag{B.12}$$

By implicit function theorem, we have

$$\varepsilon_{q,z^M} \equiv \frac{z^M}{q}\frac{\partial q}{\partial z^M} = -\frac{z^M}{q}\frac{\partial F(q,z^M)/\partial z^M}{\partial F(q,z^M)/\partial q}$$

Combining with Equations (B.11), (B.12), we get

$$\varepsilon_{q,z^M} = \frac{\widetilde{\vartheta}^H q^{1-\eta} + \widetilde{\vartheta}^M}{[(1-\alpha^M)\eta + \alpha^M]\,\widetilde{\vartheta}^H q^{1-\eta} + \widetilde{\vartheta}^M} \Rightarrow \frac{1}{\varepsilon_{q,z^M}} = 1 - (1-\alpha^M)(1-\eta)\underbrace{\frac{\widetilde{\vartheta}^H q^{1-\eta}}{\widetilde{\vartheta}^H q^{1-\eta} + \widetilde{\vartheta}^M}}_{>0} \tag{B.13}$$

Since $\alpha^M \in (0,1)$, when $\eta = 1$, $\varepsilon_{q,z^M} = 1$; when $\eta < 1$, $\varepsilon_{q,z^M} > 1$, and when $\eta > 1$, $\varepsilon_{q,z^M} < 1$.

3. The partial derivative of left-hand side with respect to $\widetilde{\zeta}^E$ is

$$\frac{\partial[z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E]}{\partial\widetilde{\zeta}^E} = \alpha^E z^E (\widetilde{\zeta}^E)^{\alpha^E - 1} - \delta,$$

noticing that $\alpha^E < 1$. We set this partial derivative to zero,

$$(\widetilde{\zeta}^E)^{1-\alpha^E} = \frac{\alpha^E z^E}{\delta} \Rightarrow \delta\widetilde{\lambda}^E\widetilde{\chi}^E = 1$$

Thus, residual supply $z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E$ increases when $\widetilde{\lambda}^E\widetilde{\chi}^E < 1/\delta$, and then decreases.

B.1.4 Proof of Proposition 3

We start with proving Proposition 3, which serves as a premise to prove Proposition 2. We can rewrite Equation (B.5) as

$$\alpha^j\widetilde{\lambda}^j\widetilde{\chi}^j p^j y^j = q l^j \tag{B.14}$$

that is, at the steady state, the value of collateral ql^j is proportionate to the revenue of the firm $p^j y^j$. By definition, we have

$$\kappa^j \equiv \frac{d^\lambda}{d} = \frac{\lambda^j q^j l^l + \chi^j p^j y^j}{p^j y^j} = \lambda^j \frac{q l^j}{p^j y^j} + \chi^j = \alpha^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j + \chi^j$$

Correspondingly, the mortgage share is given by

$$\omega^j = \frac{\lambda^j q^j l^j}{d^j} = \frac{\alpha^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j}{\kappa^j}$$

B.1.5 Proof of Propositions 2

1. By Equation (B.14), we have

$$d^j = \kappa^j p^j y^j = \underbrace{\left(\lambda^j + \frac{\chi^j}{\alpha^j \widetilde{\lambda}^j \widetilde{\chi}^j}\right)}_{\mathbf{\Lambda}^j_{d,1}} q l^j.$$

By Equation (4), we have

$$\frac{l^E}{l^M} = \frac{(\alpha^E z^E \widetilde{\lambda}^E \widetilde{\chi}^E)^{\frac{1}{1-\alpha^E}}}{(\alpha^M z^M \widetilde{\lambda}^M \widetilde{\chi}^M)^{\frac{1}{1-\alpha^M}}} q^{\frac{1}{1-\alpha^M}} = \frac{\mathbf{Z}^E}{\mathbf{Z}^M} \underbrace{\frac{(\alpha^E \widetilde{\lambda}^E \widetilde{\chi}^E)^{\frac{1}{1-\alpha^E}}}{(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)^{\frac{1}{1-\alpha^M}}}}_{(\mathbf{\Lambda}^E_y)^{1/\alpha^E} / (\mathbf{\Lambda}^M_d)^{1/\alpha^M}} \mathbf{Q} \propto \left(\frac{q}{z^M}\right)^{\frac{1}{1-\alpha^M}}. \tag{B.15}$$

Due to $\mathbf{\Lambda}^j_d = \mathbf{\Lambda}^j_{d,1}(\mathbf{\Lambda}^j_y)^{1/\alpha^j}$, we can decompose the credit ratio as Equation (6). Similarly, we can write the nominal output ratio as

$$\frac{qy^E}{y^M} = \frac{z^E}{z^M}\frac{(l^E)^{\alpha^E}}{(l^M)^{\alpha^M}} q = \underbrace{\frac{z^E}{z^M}\frac{(z^E)^{\frac{\alpha^E}{1-\alpha^E}}}{(z^M)^{\frac{\alpha^M}{1-\alpha^M}}}}_{\mathbf{Z}^E/\mathbf{Z}^M} \underbrace{\frac{(\alpha^E \widetilde{\lambda}^E \widetilde{\chi}^E)^{\frac{\alpha^E}{1-\alpha^E}}}{(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)^{\frac{\alpha^M}{1-\alpha^M}}}}_{\mathbf{\Gamma}^E_y/\mathbf{\Gamma}^M_y} \underbrace{q^{\frac{\alpha^M}{1-\alpha^M}} q}_{\mathbf{Q}} \propto \left(\frac{q}{z^M}\right)^{\frac{1}{1-\alpha^M}}, \tag{B.16}$$

which is exactly the decomposition result in Equation (6). Notice that both shares is proportionate to $(q/z^M)^{\frac{1}{1-\alpha^M}}$, by Proposition 1, we complete the proof of Proposition 2.

2. Consider the case when $\eta = 1$. We can write nominal output ratio as

$$\frac{qy^E}{y^M} = \frac{y^E}{\frac{z^M}{q}\left(\frac{\alpha^M z^M \widetilde{\lambda}^M \widetilde{\chi}^M}{q}\right)^{\frac{\alpha^M}{1-\alpha^M}}} = \frac{y^E}{(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)^{\frac{\alpha^M}{1-\alpha^M}}}\left(\frac{q}{z^M}\right)^{\frac{1}{1-\alpha^M}}$$

Substituting q/z^M from Equation (B.10) and rearranging, we have

$$\frac{qy^E}{y^M} = \frac{y^E}{y^E - \delta l^E}\left[\frac{\widetilde{\vartheta}^H + \widetilde{\vartheta}^M}{(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)^{\frac{\alpha^M}{1-\alpha^M}}}\right] = \frac{1}{1 - \delta\frac{(l^E)^{1-\alpha^E}}{z^E}}\left[s + \delta(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)\right] = \frac{s + \delta(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)}{1 - \delta(\alpha^E \widetilde{\lambda}^E \widetilde{\chi}^E)}$$

which increases with λ^E, λ^M, χ^M and χ^E.

By Proposition 3, the credit to output ratio κ^j increases with λ^j and χ^j. So the credit ratio increases with λ^E and χ^E.

$$\frac{d^E}{d^M} = \frac{\alpha^E \lambda^E \widetilde{\lambda}^E \widetilde{\chi}^E + \chi^E}{\alpha^M \lambda^M \widetilde{\lambda}^M \widetilde{\chi}^M + \chi^M} \frac{s + \delta(\alpha^M \widetilde{\lambda}^M \widetilde{\chi}^M)}{1 - \delta(\alpha^E \widetilde{\lambda}^E \widetilde{\chi}^E)}$$

We don't have definite results for how credit share changes with λ^M and χ^M. Since less binding financial constraint in manufacturing sector, on one hand, increases the sectoral debt capacity, measured by credit to output ratio; on the other hand, increases the collateral price and encourages the distribution of nominal output from the manufacturing sector.

Under two special cases that there are only one type of borrowing, either asset-based or cash flow-based borrowing, the credit ratio decreases when financial constraint in manufacturing sector is relaxed. When $\chi^j = 0$ for all j, that is $\widetilde{\chi}^j = 1$, we have

$$\frac{d^E}{d^M} = \frac{\lambda^E}{\lambda^M} \frac{\frac{s}{\alpha^M \widetilde{\lambda}^M} + \delta}{\frac{1}{\alpha^E \widetilde{\lambda}^E} - \delta},$$

which increases with λ^E and decreases with λ^M. And when $\lambda^j = 0$, that is $\widetilde{\lambda}^j = \frac{\beta}{1-\beta(1-\delta)}$, we have

$$\frac{d^E}{d^M} = \frac{\chi^E}{\chi^M} \frac{s + \frac{\beta\delta}{1-\beta(1-\delta)} \alpha^M}{1 - \frac{\beta\delta}{1-\beta(1-\delta)} \alpha^E}$$

which increases with χ^E and decreases with χ^M.

B.2 Model Discussions

Here we provide some discussion for our baseline model.

Residential Service Flow Instead of agents investing in residential housing, our model assumes that the residential housing stock converts to intra-period residential housing services at a fixed rate. This setting simplifies the model, allowing us to aggregate the total manufacturing goods and residential housing consumption across different agents. As shown in Equation B.7, the FOC of h solely depends on the current period collateral price. In other words, the total consumption of manufacturing goods and residential housing at the steady state depends only on the total income in the economy, not on how income is distributed among agents. In contrast, an alternative model involving agents investing in residential housing is complicated by the redistribution of wealth among agents, which is not the main focus of this paper.

We want to emphasize that our assumption for residential service flow *does not affect* the decomposition identity in Equations (5) and (6). This assumption will only affects the equilibrium collateral price without changing other components. Unfortunately, we don't have an analytical comparative statics in Propositions 1 and 2 anymore, because we need to figure out how an increase of z^M, for example, affects $\{c^i\}_{i\in\{S,M,E\}}$ *separately*. After figuring out this, we can know how it changes the aggregate consumption c and h. However, we want to stress that the quantitative difference with or without this assumption is negligible.

There are two potential economic interpretations of s: first, at the steady-state equilibrium, when residential housing investment is fully depreciated, s can be interpreted as a demand shifter as in Liu et al. (2013) or as the housing demand channel of credit expansion as in Mian et al. (2020). Second, it can be micro-founded by a competitive housing service market that uses the housing stock to produce housing services with a fixed efficiency. We formalize this micro-foundation in Proposition B.5.

Steady States Equilibrium Instead of Generalized Balanced Growth Path (GBGP) Moreover, solving the generalized balanced-growth path analytically, as done in the structural transformation literature (Buera, Kaboski, Mestieri, and O'Connor, 2020), is complicated. Instead, we consider economies with different income levels at their own steady states and ask how different levels of a same set of exogenous parameters (such as sectoral TFP) affect the endogenous variables (such as credit share). We evaluate the model at the steady state and map it to empirical results, following the common approach in macro-development literature.

Non-Homothetic Preference Lastly, we also include an extension with non-homothetic preference as Kongsamut et al. (2001), which contributes substantially to the structural change in the real economy, as in Herrendorf et al. (2013). We show that under some parametric restrictions, for example, there is no substance level for manufacturing good consumption, our main results still hold. Intuitively, the demand side modification, as shown in Proposition B.9, only alters the level of collateral price, but does not affect ε_{q,z^M}.

B.3 Proof of Auxiliary Results

In this section, we prove several additional results.

Proposition B.2 shows how change of preference parameter η affect the endogenous variable of collateral price q, credit share d^E/d^M and nominal output share qy^E/y^M. This result provides some foundation for our calibration strategy to match collateral price and nominal output share to calibrate η.

Proposition B.3 shows that, under a more general setting, the credit to output ratio only depends on (i) the sum of shares of collateralized inputs (ii) parameters of collateral constraints (and their transformations).

Proposition B.4 shows how we can use the sectoral credit to output ratio and mortgage share to identify λ^j and χ^j in the financial constraints. Not only does this result provide the intuition how different types of borrowing affect these two sectoral moments, but, more importantly, this result shows theoretically the validity to identify λ^j and χ^j in Section 5.1 by using these two carefully chosen moments (Nakamura and Steinsson, 2018). This pair of moments uniquely identifies these two parameter collectively, following the similar fashion in David et al. (2016) and David and Venkateswaran (2019).

Proposition B.5 provides a tractable framework to show s can be interpreted as the productivity of the firm converting the residential housing stock into service.

Proposition B.2 (Impact of s and η on Collateral Price, Credit and Nominal Output Share)**.** *Collateral price q, credit ratio d^E/d^M, nominal output ratio qy^E/y^M increases with s, holding all other fixed.*

Proof. The proof is straightforward.

1. Proof for s is in Proposition 1.
2. Recall that s affects credit share only through the term $f(s,\eta) = s^\eta q(s,\eta)^{1-\eta}$. We again rewrite the market clearing condition (B.9) into

$$z^E(\widetilde{\zeta}^E)^{\alpha^E} - \delta\widetilde{\zeta}^E = \left[(\alpha^M\widetilde{\lambda}^M\widetilde{\chi}^M)^{\frac{\alpha^M}{1-\alpha^M}} \underbrace{s^\eta q^{1-\eta}}_{f(s,\eta)} + \widetilde{\vartheta}^M\right](z^M)^{\frac{1}{1-\alpha^M}} q^{-\frac{1}{1-\alpha^M}} \tag{B.17}$$

   An increase of s increases q from part 1, which implies the term in the bracket should increase to balance the equation, which implies $f(s,\eta)$ increases with s.
3. The result for nominal output ratio is directly from Proposition 3 and part 2.

■

Proposition B.3 (Sectoral Credit to Added Generalization)**.** *If the following three assumptions hold,*

1. *The production function is*

$$y(\mathbf{l},\mathbf{m}) = zm(\mathbf{m})\prod_{k=1}^{K} l_k^{\alpha_k},$$

   where $\mathbf{l}$ is a K dimensional vector capturing all collateralized input, l_k is the k-th type of collateralized capital, $\mathbf{m}$ is a vector of other inputs, and m is an arbitrary differentiable function;
2. *All collateralized capital share the same depreciation rate δ;*
3. *The collateral constraint, at the steady state, follows*

$$d = \lambda\sum_{k=1}^{K} p_k l_k + \chi p y$$

then the credit to output ratio is given by

$$\kappa = \left(\sum_{k=1}^{K}\alpha_k\right)\lambda\widetilde{\lambda}\widetilde{\chi} + \chi \tag{B.18}$$

Notice that in our benchmark model is a special cases where $\mathbf{m} = 1$, and $K = 1$. The proof, at heart, follows the same intuition.

Proof. The FOC for the k-th collateral capital is

$$\alpha^k p \frac{y(\mathbf{l}, \mathbf{m})}{l_k} = \frac{p_k}{\widetilde{\lambda}\widetilde{\chi}} \Rightarrow \alpha^k \widetilde{\lambda}\widetilde{\chi} p y(\mathbf{l}, \mathbf{m}) = p_k l_k, \tag{B.19}$$

where p is the price of good produced in that sector, and $\widetilde{\lambda}$ and $\widetilde{\chi}$ are the same expression as in the benchmark model. By definition,

$$\kappa = \frac{d}{py(\mathbf{l}, \mathbf{m})} = \frac{\lambda \sum_{k=1}^{K} p_k l_k + \chi p y}{py(\mathbf{l}, \mathbf{m})} = \left(\sum_{k=1}^{K} \alpha_k \right) \lambda \widetilde{\lambda} \widetilde{\chi} + \chi \tag{B.20}$$

∎

Proposition B.4 (Identification of λ^j and χ^j)**.** *Under the assumptions in Proposition B.3, the financial constraint parameters λ^j and χ^j are uniquely identified by the moments κ^j and ω^j.*

Proof. We denote the real estate collateral input share as α_l^j. Since $\widetilde{\lambda}^j$ increases with λ^j, and $\widetilde{\chi}^j$ increases with χ^j, we have

$$\frac{\partial \kappa^j}{\partial \lambda^j} > 0, \quad \frac{\partial \kappa^j}{\partial \chi^j} > 0 \tag{B.21}$$

In other words, slackening the financial constraint λ^j or χ^j leads to a higher credit to output ratio.

Next, we can rewrite the sectoral mortgage share as

$$\omega^j = \frac{\alpha_l^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j}{\left(\sum_{k=1}^{K} \alpha_k^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j \right) + \chi^j} = \frac{\alpha_l^j}{\left(\sum_{k=1}^{K} \alpha_k^j \right) + \frac{\chi^j}{\lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j}} = \frac{\alpha_l^j}{\left(\sum_{k=1}^{K} \alpha_k^j \right) + \left[\lambda^j \widetilde{\lambda}^j \left(\frac{1}{\chi^j} + \beta^S - \beta \right) \right]^{-1}}$$

which implies

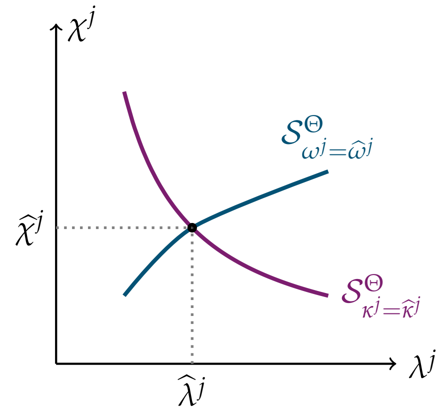
$$\frac{\partial \omega^j}{\partial \lambda^j} > 0, \quad \frac{\partial \omega^j}{\partial \chi^j} < 0 \tag{B.22}$$

As in David and Venkateswaran (2019), we introduce the notion of *isomoment* curve, a level set tracing out combinations of the two parameters that give rise to a given value of the relevant moment, holding the other parameters fixed. Mathematically, the isomoment curve for moment κ^j with estimated value $\widehat{\kappa}^j$ and for moment ω^j with estimated value $\widehat{\omega}^j$ are defined as

$$\mathcal{S}^{\Theta}_{\kappa^j = \widehat{\kappa}^j} \equiv \left\{ (\lambda^j, \chi^j) : \kappa^j(\lambda^j, \chi^j; \Theta_-) = \widehat{\kappa}^j \right\}, \quad \mathcal{S}^{\Theta}_{\omega^j = \widehat{\omega}^j} \equiv \left\{ (\lambda^j, \chi^j) : \omega^j(\lambda^j, \chi^j; \Theta_-) = \widehat{\omega}^j \right\},$$

where $\Theta_- \equiv \Theta \setminus \{\lambda^j, \chi^j\}$, Θ is a set of parameters in the model.

Figure B.1: Isomoment Curve of κ^j and ω^j



Note: This figure plots the isomoment curves of κ^j and ω^j with estimated value $\widehat{\kappa^j}$ and $\widehat{\omega}^j$. The former one is downward sloping in purple, and the latter one is upward sloping in dark blue. The unique intersection pins down the estimated values of parameters $\widetilde{\lambda}^j$ and $\widetilde{\chi}^j$.

From Equation B.21, we know the isomoment curve of κ^j slopes downward as in Figure B.1, by implicit function theorem. Intuitively, a higher level of λ^j and χ^j have similar effects on κ^j. By contrast, from Equation B.22, the isomoment curve of ω^j in Figure B.1 slopes downward since a higher λ^j and a lower χ^j both contribute to higher ω^j. These two isomoment curves intersect at a unique point, which identify λ^j and χ^j jointly. ∎

Proposition B.5 (Residential Housing Stock and Service Flow)**.** *Denote the parameters in this environment as $\mathring{x}$. Suppose there is a zero-profit residential housing service firm converts the stock of residential housing $\mathring{h}$ to service with quantity $\mathring{h}^{SF} = \mathring{x}\mathring{h}$. Denote $\mathring{q}$ is the price for collateral or stock of residential housing, $\mathring{q}^{SF}$ is the price for residential housing service, and $\mathring{x}$ is the productivity of that firm. In this setting, the FOC from the consumption side* (B.7) *in the benchmark can be recovered using the following transformation of parameter $s = \mathring{x}^{-\frac{1-\eta}{\eta}}\mathring{s}$.*

Proof. The profit for this residential service firm is given by $\mathring{\pi} = \mathring{q}^{SF}\mathring{h}^{SF} - \mathring{q}\mathring{h}$, implying that $\mathring{x}\mathring{q}^{SF} = \mathring{q}$. The FOC from the consumption side is literally the same as Equation (B.7). Altogether, we have $\frac{\mathring{c}}{\mathring{x}\mathring{h}} = \left[\frac{\mathring{q}/\mathring{x}}{\mathring{s}}\right]^{\eta}$, which can be converted to our benchmark FOC by setting $s^{-\eta} = \mathring{x}^{1-\eta}\mathring{s}^{-\eta}$. ∎

B.4 Adding Intangible Assets

In this section, we consider the case that firms also make intangible asset investment. We rationalize how the collateral quantity channel stems from sectoral specific variation of asset tangibility.

To simplify our analysis, investment in intangible asset k^j is costly and happens within each period. There are two modifications compared to our benchmark model.

First, the production function is modified as

$$y^j = z^j(\iota^j)^{\alpha^j}, \text{ where } \iota^j = \left[(\nu^j_l)^{\frac{1}{\psi}}(l^j)^{\frac{\psi-1}{\psi}} + (1-\nu^j_l)^{\frac{1}{\psi}}(k^j)^{\frac{\psi-1}{\psi}}\right]^{\frac{\psi}{\psi-1}}, \tag{B.23}$$

where $0 < \nu_l \leq 1$ measures the asset tangibility, $0 < \psi \leq 1$ is the elasticity of substitution between the intangible and tangible asset investment as in Falato et al. (2022). When $\nu_l = 1$ and $\psi \to 1$, the production function (B.23) degenerates to that in our benchmark model.

Second, we assume the *price* of intangible asset investment is the same as tangibles. This assumption helps us get rid of tedious price channel and the main implication does not change even if the price of sectoral intangible is the same as the price of sectoral output, which we will elaborate later.

One last key feature for intangible assets is that they are not collateralized for raising debt. So the financial constraint remains the same as in our benchmark model.

Compared to our benchmark model, the only changes are the FOCs for l^j_{t+1} and k^j_{t+1}. Evaluating them at the steady states, we have

$$[1 + \chi(\beta^S - \beta)]\beta p^j \frac{\partial y^j}{\partial l^j} = q[1 - \beta(1 - \delta_l) - \lambda^j(\beta^S - \beta)] \tag{B.24}$$

$$[1 + \chi(\beta^S - \beta)]\beta p^j \frac{\partial y^j}{\partial k^j} = q[1 - \beta(1 - \delta_k)] \tag{B.25}$$

where

$$\frac{\partial y^j}{\partial l^j} = (\nu^j_l)^{\frac{1}{\psi}} z^j \alpha^j (\iota^j)^{\alpha^j - 1 + \frac{1}{\psi}} l^{-\frac{1}{\psi}}, \quad \frac{\partial y^j}{\partial k^j} = (1 - \nu^j_l)^{\frac{1}{\psi}} z^j \alpha^j (\iota^j)^{\alpha^j - 1 + \frac{1}{\psi}} k^{-\frac{1}{\psi}} \tag{B.26}$$

and $\widetilde{\lambda}^j$ and $\widetilde{\chi}^j$ follows the definition in the benchmark model.

Proposition B.6 (Intangible to Tangible Asset Ratio)**.** *The sectoral intangible to tangible asset ratio*

1. *decreases with* $1 - \nu^j_l$*;*
2. *decreases with* δ_k*, increases with* δ_l*,*
3. *decreases with* λ^j
4. *increases with increases with* ψ *if* $\delta_l \leq \delta_k$*.*

Proof. Combining Equations (B.24) and (B.25), we have the intangible to tangible ratios

$$\frac{k^j}{l^j} = \frac{1 - \nu^j_l}{\nu^j_l} \Lambda^{\psi}, \text{ where } \Lambda = \frac{1 - \beta(1 - \delta_l) - \lambda^j(\beta^S - \beta)}{1 - \beta(1 - \delta_k)} < 1 \tag{B.27}$$

which increases with ν^j_l. ∎

Proposition B.6 shows the connection between asset tangibility ν_l and intangible share. As $\nu^j_l \to 1$, we have $l^j/(l^j + k^j) \to 1$, coinciding our baseline result. If the ν^M_l decreases over development and ν^E_l is close to 1, we expect to see that intangible share goes up in manufacturing and remains low in real estate. We defer the discussion of this setting in Proposition B.8. Secondly, the faster the intangible asset depreciates, the less firm invest in that, since it is more costly. Similar analysis applies for δ_l. Thirdly, a higher λ^j encourages more asset-based borrowing. Since intangible asset is not collateralized, this discourages investment in intangible assets. Fourth, when $\delta_l \leq \delta_k$, then a higher ψ, the elasticity of substitution between intangible and tangible assets, indicates lower intangible share. The assumption for depreciation rates of these two types of asset is empirically and quantitatively comparable to previous studies that δ_l is 0.19 (Hall, 2007; Falato and Sim, 2014) and δ_k is 0.145 and 0.15 (Gomes, 2001; Riddick and Whited, 2009).

As a remark for the price effect which we shut down for simplicity, if we alternatively assume that the price for intangible investment is the same as the price of good of that sector, then the increase in relative price of tangible asset q will further induce more investment in tangible asset in manufacturing as economy becomes richer. Hence, if anything, the result in Proposition B.6 is conservative.

Proposition B.7 illustrates that an increase of asset intangibility $1-\nu_l^j$ acts *as if* a decrease in the credit to output ratio through the collateral input share α^j.

Proposition B.7 (Credit to Output Ratio With Intangible Asset Investment)**.** *When* $0 < \psi \leq 1$, *the sectoral credit to output ratio* κ^j *increases with* $1-\nu_l^j$.

Proof. By Equation (B.24), we have

$$\alpha^j p^j \underbrace{z^j (\iota^j)^{\alpha^j}}_{y^j} \nu_l^{\frac{1}{\psi}} (\iota^j / l^j)^{\frac{1-\psi}{\psi}} = \frac{q l^j}{\widetilde{\lambda}^j \widetilde{\chi}^j}$$

Thus, the credit to output ratio is given by

$$\kappa^j = \widetilde{\alpha}^j \lambda^j \widetilde{\lambda}^j \widetilde{\chi}^j + \chi^j, \text{ where } \widetilde{\alpha}^j \equiv \alpha^j (\nu_l^j)^{\frac{1}{\psi}} (\iota^j / l^j)^{\frac{1-\psi}{\psi}}$$

By Equation (B.23), we have

$$\frac{\iota^j}{l^j} = [(\nu_l^j)^{\frac{1}{\psi}} + (1-\nu_l^j)^{\frac{1}{\psi}} (k^j / l^j)^{\frac{\psi-1}{\psi}}]^{\frac{\psi}{\psi-1}}$$

Then substituting with (B.27), we obtain

$$\widetilde{\alpha}^j = \alpha^j \left[1 + \left(\frac{1-\nu_l^j}{\nu_l^j}\right)^{\frac{1}{\psi}} \left(\frac{k^j}{l^j}\right)^{\frac{\psi-1}{\psi}}\right]^{-1} = \alpha^j \left[1 + \frac{1-\nu_l^j}{\nu_l^j} \Lambda^{\psi-1}\right]^{-1}$$

Noticing that $\widetilde{\alpha}^j$ is increasing with ν_l^j, we have κ^j decreases with $1-\nu_l^j$. ∎

Proposition B.7 indicates that the endogenous collateral quantity channel can be rationalized by the change of sectoral asset tangibility.

Our results in Proposition B.6 and B.7 relies on the strong assumption that ν_l^E does not change and ν_l^M decreases over development. However, such process should endogenously evolve over development.

To make sense of this assumption, we argue that this setting is *isomorphic* to an alternative setting with two assumptions: (1) ν_l^j is constant over development, and (2) for each sector and intangible asset investment is relatively more complementary with sectoral TFP than tangible asset investment with that, i.e., $\frac{\partial^2}{\partial z^j \partial k^j} y^j(z^j, k^j, l^j) > \frac{\partial^2}{\partial z^j \partial l^j} y^j(z^j, k^j, l^j)$ in a CES production function; (3) the real estate sector TFP barely varies but manufacturing TFP soars over development.

Altogether, the change of sectoral TFP over development acts as if the asset tangibility declines in manufacturing but not in real estate. We provide a concrete example in Proposition B.8.

Proposition B.8 (TFP Complementarity Production Function)**.** *If ι^j in production function* (B.23) *admits*

$$\iota^j = \left[(\mathring{\nu}_l^j)^{\frac{1}{\psi}} (l^j)^{\frac{\psi-1}{\psi}} + (1 - \mathring{\nu}_l^j)^{\frac{1}{\psi}} g(z^j) (k^j)^{\frac{\psi-1}{\psi}} \right]^{\frac{\psi}{\psi-1}}, \tag{B.28}$$

where $\mathring{\nu}_l^j$ is fixed, and $g(z)$ is monotonically increasing and differentiable. Then an increase of z^j with fixed $\mathring{\nu}_l^j$ is isomorphic to a decrease of $1 - \nu_l^j$ in the in production function (B.23).

Proof. The only difference appears in Equation (B.26) with following modification

$$\frac{\partial y^j}{\partial k^j} = g(z^j) \left[(1 - \mathring{\nu}_l^j)^{\frac{1}{\psi}} z^j \alpha^j (\iota^j)^{\alpha^j - 1 + \frac{1}{\psi}} k^{-\frac{1}{\psi}} \right],$$

which implies

$$\frac{k^j}{l^j} = g(z^j) \frac{1 - \mathring{\nu}_l^j}{\mathring{\nu}_l^j} \Lambda^\psi.$$

Since g is increasing, an increase of z^j with fixed $\mathring{\nu}_l^j$ is isomorphic with a decrease of ν_l^j via the following mapping

$$\nu_l^j = \left(1 + \frac{1 - \mathring{\nu}_l^j}{\mathring{\nu}_l^j} g(z^j) \right)^{-1},$$

which is decreasing with z^j. Notice that when in this specification

$$\frac{\partial^2}{\partial z^j \partial k^j} y^j(z^j, k^j, l^j) > \frac{\partial^2}{\partial z^j \partial l^j} y^j(z^j, k^j, l^j) = 0,$$

where $g(z)$ governs the relative complementarity between sectoral TFP and intangible or tangible asset investment. ∎

B.5 Adding Non-homoethetic Preference

In this section, we consider how non-homothetic utility function affect model prediction. Specifically, the utility function rewrites as

$$C_t^i = \left[(c_t^i - \underline{c}^i)^{\frac{\eta-1}{\eta}} + s(h_t^i + \overline{h}^i)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \tag{B.29}$$

And the FOC from the consumption side (B.7) becomes

$$\frac{c^i - \underline{c}^i}{h^i + \overline{h}^i} = \left[\frac{q}{s} \right]^\eta$$

For simplicity, we denote that $\sum_i \underline{c}^i = \underline{c}$ and $\sum_i \overline{h}^i = \overline{h}$, then the relationship of aggregate consumption and housing service

$$c_t - \underline{c} = q_t^\eta (h_t + \overline{h})$$

Substituting back to the market clearing condition for real estate sector (7), we get

$$z^E (\widetilde{\zeta}^E)^{\alpha^E} - \delta \widetilde{\zeta}^E = \widetilde{\zeta}^H q^{-\eta - \frac{\alpha^M}{1-\alpha^M}} + \delta \widetilde{\zeta}^M q^{-\frac{1}{1-\alpha^M}} - (q^{-\eta} \underline{c} + \overline{h}) \tag{B.30}$$

Assumption B.2 (Parametric Restriction of Non-homothetic Preference)**.**

$$q^{-\eta} \underline{c} + \overline{h} = \Xi,$$

where Ξ is a constant.

Proposition B.9. *Under Assumption B.2, Proposition B.1, and Propositions 1 to 3 hold.*

Proof. When $q^{-\eta}\underline{c} + \overline{h}$ is constant, the change of Ξ only affect the level of q, but does not affect the elasticity of collateral price with respect to manufacture TFP, denoted by ε_{q,z^m}. Notice that Equations (B.11) to (B.13) are unchanged, which implies ε_{q,z^M} is the same as the benchmark model. Lastly, the sectoral credit to output ratio satisfies the assumptions in B.3, and thus the baseline Proposition 3 holds. ■

To gain some intuitions of Assumption B.2, we consider two simple cases. First, when $q^{-\eta}\underline{c} + \overline{h} = 0$, Equation (B.30) degenerates to the benchmark market clearing condition for real estate good (7). This restriction is similar with Kongsamut et al. (2001) to ensure the balanced growth path in the demand-side structural change model. In that class of model, the sectoral price level does not change on the balanced growth path. The second case is that $\underline{c} = 0$, that is, there is no sustenance level of manufacture goods consumption.

C Supplementary Materials for Quantitative Results

In this section, we describe two modifications for the benchmark model, derive the corresponding new/additional conditions, characterize the equilibrium in the extended model, and generate similar model predictions as those from our benchmark model.

C.1 Quantitative Model

We set up the baseline quantitative model for calibration in Section C.1.1, provides the model predicted collateral price channel and decomposition rule for structural change in Section C.1.2, outlines the computation algorithm in Section C.1.3, extends this model with capital as tangible asset in Section C.1.4.

C.1.1 Set Up of Quantitative Model

We incorporate two additional features relative to our benchmark model. First, we labor input in our production function. This revision provides the model-implied sectoral labor productivity. We calibrate the sectoral TFP to match these moments, which can be easily estimated in the data. Second, agents can invest residential housing instead of enjoying the residential housing service flow.

The production function changes to

$$y^j = z^j (l^j)^{\alpha_l^j} (n^j)^{\alpha_n^j}, \tag{C.1}$$

where l^j and n_j are the commercial land and labor input, with input shares α_l^j and α_n^j, respectively. The firm needs to pay for the labor cost wn^j. Specifically, the flow of fund constraint changes to

$$c_t^j + q_t \left[h_{t+1}^j - (1-\delta_h) h_t \right] + q_t \left[l_{t+1}^j - (1-\delta) l_t^j \right] + d_t^j = p_t^j y_t^j - w_t n_t^j + \frac{d_{t+1}^j}{1+r_t}, \tag{C.2}$$

And savers supply 1 unit of labor inelastically, which implies the labor market clearing condition

$$n^M + n^E = 1 \tag{C.3}$$

The FOCs for collateral l and labor n are

$$\alpha_n^j p_t^j z_t^j (l_t^j)^{\alpha_l^j} (n_t^j)^{\alpha_n^j - 1} = w_t \tag{C.4}$$

$$(1+\theta_{t+1}^j \chi_t) \alpha_l^j \beta \phi_{t+1}^j p_{t+1}^j z_{t+1}^j (l_{t+1}^j)^{\alpha_l^j - 1} (n_{t+1}^j)^{\alpha_n^j} + \theta_t^j \lambda_t^j q_{t+1} = \phi_t^j q_t - \beta(1-\delta) \phi_{t+1}^j q_{t+1} \tag{C.5}$$

Now evaluating both equation at the steady states, and substituting Equation (C.4) into (C.5), we have

$$n=\frac{\alpha_n^j}{\alpha_l^j}\frac{ql}{\widetilde{\lambda}^j\widetilde{\chi}^j w},\quad \alpha_l^j p^j z^j\left(\frac{\alpha_n^j}{\alpha_l^j w}\right)^{\alpha_n^j}\left(\frac{\widetilde{\lambda}^j\widetilde{\chi}^j}{q}\right)^{1-\alpha_n^j}=l^{1-\alpha_l^j-\alpha_l^j} \tag{C.6}$$

where the definition of $\widetilde{\lambda}^j$ and $\widetilde{\chi}^j$ is the same as the baseline model.

We need to change $q_t h_t$ in the flow of fund constraint into $q_t\left[h_{t+1}^j-(1-\delta_h)h_t^j\right]$, where δ_h is the depreciation of residential housing for all agents. And for savers, they earn wage rate w. Now, the FOC for h_{t+1}^j is given by

$$\beta v_h(c_{t+1}^j,h_{t+1}^j)=\phi_t^j q_t-\beta(1-\delta_h)\phi_{t+1}^j q_{t+1}^j \tag{C.7}$$

To see the importance of the assumption about hosing service flow in the benchmark model, we evaluate Equation (C.7) at the steady state and combine with FOC for c_t^j, obtaining that

$$\frac{c^j}{h^j}=\left[\frac{1-\beta(1-\delta_h)}{\beta s}q\right]^{\eta},\quad \frac{c^S}{h^S}=\left[\frac{1-\beta^S(1-\delta_h)}{\beta^S s}q\right]^{\eta} \tag{C.8}$$

Compared to the benchmark model, we lose the simple aggregation rule to derive c/h since the discount factor for savers and entrepreneur are different.

Correspondingly, the flow of fund constraint at the steady state is given by

$$c^j+\delta_h qh^j=p^jy^j-\left(wn^j+\delta ql^j+\frac{r}{1+r}d^j\right) \tag{C.9}$$

$$c^S+\delta_h qh^S=\frac{r}{1+r}b+w \tag{C.10}$$

and the market clearing condition for real estate good changes to

$$y^E=\delta_h\sum_{i\in\{S,M,E\}}h^i+\delta\sum_{i\in\{M,E\}}l^j \tag{C.11}$$

In this extended model, the steady state equilibrium consist of allocations $(c^i,h^i,l^j,n^j,y^j,d^j,b)$ ($2\times3+4\times2+1=15$ variables) for $i\in\{S,M,E\}$ and $j\in\{M,E\}$ as well as prices (q,w,r) (3 variables) such that

1. FOCs for c^i and h^i (C.8) (3 equations)
2. FOCs for l^j (C.5) and n^j (C.4) and production functions (C.1) ($2\times2=4$ equations)
3. flow of fund constraints (C.2) (3 equations)
4. collateral constraints (B.6) (2 equations)
5. FOC for household saving (B.2) (1 equation)
6. market clearing conditions for manufacture output, real estate output, debt (B.8) and labor (C.3) (4 equations).

Altogether, we have, by Walras' Law, $19-1=18$ equations and 18 unknown variables.

C.1.2 Prediction from Quantitative Model

We follow the notation of $\widetilde{\lambda}^j$ and $\widetilde{\chi}^j$ in the benchmark model, and define $\varrho^j = \frac{1}{1-(\alpha_l^j+\alpha_n^j)}$.

As the same intuition of Equation (6), we can decompose the credit share into direct, reallocation and collateral price effects. From Equation (C.6), we obtain

$$l^j = \left[\Omega^j \widetilde{\lambda}^j\right]^{(1-\alpha_n^j)\varrho^j} (p^j)^{\varrho^j} q^{-(1-\alpha_n^j)\varrho^j}, \text{ where } \Omega^j = \alpha_l^j \left(\frac{\alpha_n^j}{w}\right)^{\frac{\alpha_n^j}{1-\alpha_n^j}} (z^j)^{\frac{1}{1-\alpha_n^j}}.$$

And thus, the elasticity of sectoral credit to collateral price is

$$\varepsilon_{dq}^j \equiv \frac{\partial \log d^j}{\partial \log q} = 1 + \frac{\partial \log l^j}{\partial \log q} = \begin{cases} (1-\alpha_l^E)\varrho^E & \text{if } j = E, \\ -\alpha_l^M \varrho^M & \text{if } j = M \end{cases} \tag{C.12}$$

We can decompose the credit and nominal output share as

$$\frac{d^E}{d^M} = \frac{\mathbf{Z}^E}{\mathbf{Z}^M} \frac{\mathbf{\Gamma}_d^E}{\mathbf{\Gamma}_d^M} \frac{\mathbf{W}^E}{\mathbf{W}^M} \mathbf{Q}, \quad \frac{qy^E}{y^M} = \frac{d^E}{d^M} = \frac{\mathbf{Z}^E}{\mathbf{Z}^M} \frac{\mathbf{\Gamma}_y^E}{\mathbf{\Gamma}_y^M} \frac{\mathbf{W}^E}{\mathbf{W}^M} \mathbf{Q},$$

where the relative productivity channel $\mathbf{Z}$, collateral price channel $\mathbf{Q}$, and wage channel $\mathbf{W}$ are the same for credit and nominal output share,

$$\mathbf{Z}^j = (z^j)^{\varrho^j}, \quad \mathbf{Q} = q^{(1-\alpha_l^E)\varrho^E + \alpha_l^M \varrho^M}, \quad \mathbf{W}^j = (\alpha_n^j/w)^{\alpha_n^j \varrho^j},$$

while the collateral quantity effects are different for credit and nominal output share

$$\mathbf{\Gamma}_d^j = \left(\lambda^j + \frac{\chi^j}{\alpha_l^j \widetilde{\lambda}^j \widetilde{\chi}^j}\right) (\alpha_l^j \widetilde{\lambda}^j \widetilde{\chi}^j)^{(1-\alpha_n^j)\varrho^j}, \quad \mathbf{\Gamma}_y^j = (\alpha_l^j \widetilde{\lambda}^j \widetilde{\chi}^j)^{\alpha_l^j \varrho^j}$$

It is easy to verify that, as $\alpha_n^j \to 0$ (i.e. $\varrho^j \to \frac{1}{1-\alpha_l^j}$), the following components $\mathbf{Z}^j$, $\mathbf{Q}^j$, $\mathbf{\Gamma}^j$ converge to their counterparts in the benchmark model, and $\mathbf{W}^j$ converges to 1[22].

C.1.3 Computation Algorithm of Quantitative Model

We outline the computational algorithm for the steady state equilibrium, which has two layers of loops.

[22] It is easy to find $\lim_{x\to 0} x^{\frac{x}{1-x-\alpha_l^j}} = \lim_{x\to 0} \exp\left(\frac{\log(x)}{\frac{1-\alpha_l^j}{x}-1}\right) = \lim_{x\to 0} \exp\left(-\frac{x}{1-\alpha_l^j}\right) = 1$, where the second last step is by L'Hôpital's Rule.

The inner loop takes a price $\widetilde{q}$ as given, and solve for the wage rate w such that labor market clears as follows

1. Given some $\widetilde{q}$, use Equation (C.5) to express the collateral usage $l^j = l^j(w;\widetilde{q})$;
2. Given $l^j = l^j(w;\widetilde{q})$ and $\widetilde{q}$, use Equation (C.4) to express the sectoral employment as $n^j = n^j(w,\widetilde{q})$;
3. Solve the wage rate $w(\widetilde{q})$ for this particular $\widetilde{q}$ using labor market clearing condition.

The outer loop is to solve the equilibrium price q such that the nonlinear equation of real estate good market clearing condition hold, which only involves $(\widetilde{q}, w(\widetilde{q}))$.

C.1.4 Quantitative Model with Capital as Tangible Asset

In this section, we consider an additional extension that Suppose the capital share is α_k^j, then the FOCs can be written as

$$\alpha_l^j p^j \frac{y^j}{l^j} = \frac{q}{\widetilde{\lambda}^j}, \quad \alpha_k^j p^j \frac{y^j}{k^j} = \frac{1}{\widetilde{\lambda}^j}, \quad \alpha_n^j p^j \frac{y^j}{n^j} = w$$

and one additional change on the market clearing condition

$$y^M = c + \delta(k^M + k^E) \tag{C.13}$$

and change on the corresponding flow of fund constraints, and the collateral constraint

$$d_{t+1} = \lambda_t(q_{t+1}l_{t+1} + k_{t+1}) \tag{C.14}$$

noticing that the price of capital is the same as manufacturing good, which is normalized as 1.

Now, denote $\varrho^j = \frac{1}{1-\alpha_l^j-\alpha_k^j-\alpha_n^k}$.

$$l^j = \underbrace{(z^j)^{\varrho^j}}_{\mathbf{Z}^j}(p^j)^{\varrho^j} q^{-(1-\alpha_n^j-\alpha_k^j)\varrho^j} \left[(\alpha_l^j)^{1-\alpha_k^j-\alpha_n^j}(\alpha_k^j)^{\alpha_k^j}(\widetilde{\lambda}^j)^{1-\alpha_n^j}\right]^{\varrho^j} \underbrace{\left(\frac{\alpha_n^j}{w}\right)^{\alpha_n^j\varrho^j}}_{\mathbf{W}^j} \tag{C.15}$$

The decomposition of credit and nominal output share is the same but with different $\mathbf{Q}$, Γ_d^j and Γ_y^j defined as

$$\begin{aligned}
\mathbf{Q} &= q^{(\alpha_k^E+\alpha_n^E)\varrho^E+(1-\alpha_k^M-\alpha_n^M)\varrho^M}, \\
\mathbf{\Gamma}_d^j &= \lambda^j(\alpha_l^j+\alpha_k^j)\left[(\alpha_l^j)^{\alpha_l^j}(\alpha_k^j)^{\alpha_k^j}(\widetilde{\lambda}^j)^{1-\alpha_n^j}\right]^{\varrho^j} \\
\mathbf{\Gamma}_y^j &= \left[(\alpha_l^j)^{\alpha_l^j}(\alpha_k^j)^{\alpha_k^j}(\widetilde{\lambda}^j)^{\alpha_l^j+\alpha_k^j}\right]^{\varrho^j}
\end{aligned}$$

and one can notice that if we restrict α_n^j are the same, then $\mathbf{W} = \mathbf{W}^E/\mathbf{W}^M = 1$.

C.2 Additional Results for Quantitative Model

Figure D.10 demonstrates the results. First, we set the α^j in both sectors to the level of externally calibrated α^E, as the green line with circles. An increase of α^M leads to a surge in collateral demand in that sector, shifting the demand curve in Figure 2 to the right, and moving up the housing price. Compared to the baseline result, there is nothing change to the real estate sector output y^E since the housing price does not affect real estate collateral usage. Altogether, this drives up the housing price, as shown in Figure D.10c. From the real-economy side, the collateral price effect overpowers, such that the construction nominal output share increase as Figure D.10b. From the financial side, an increase of α^M significantly boosts the leverage ratio, which dominates the real-economy output reallocation, and thus there is a pronounced construction credit share decreases.

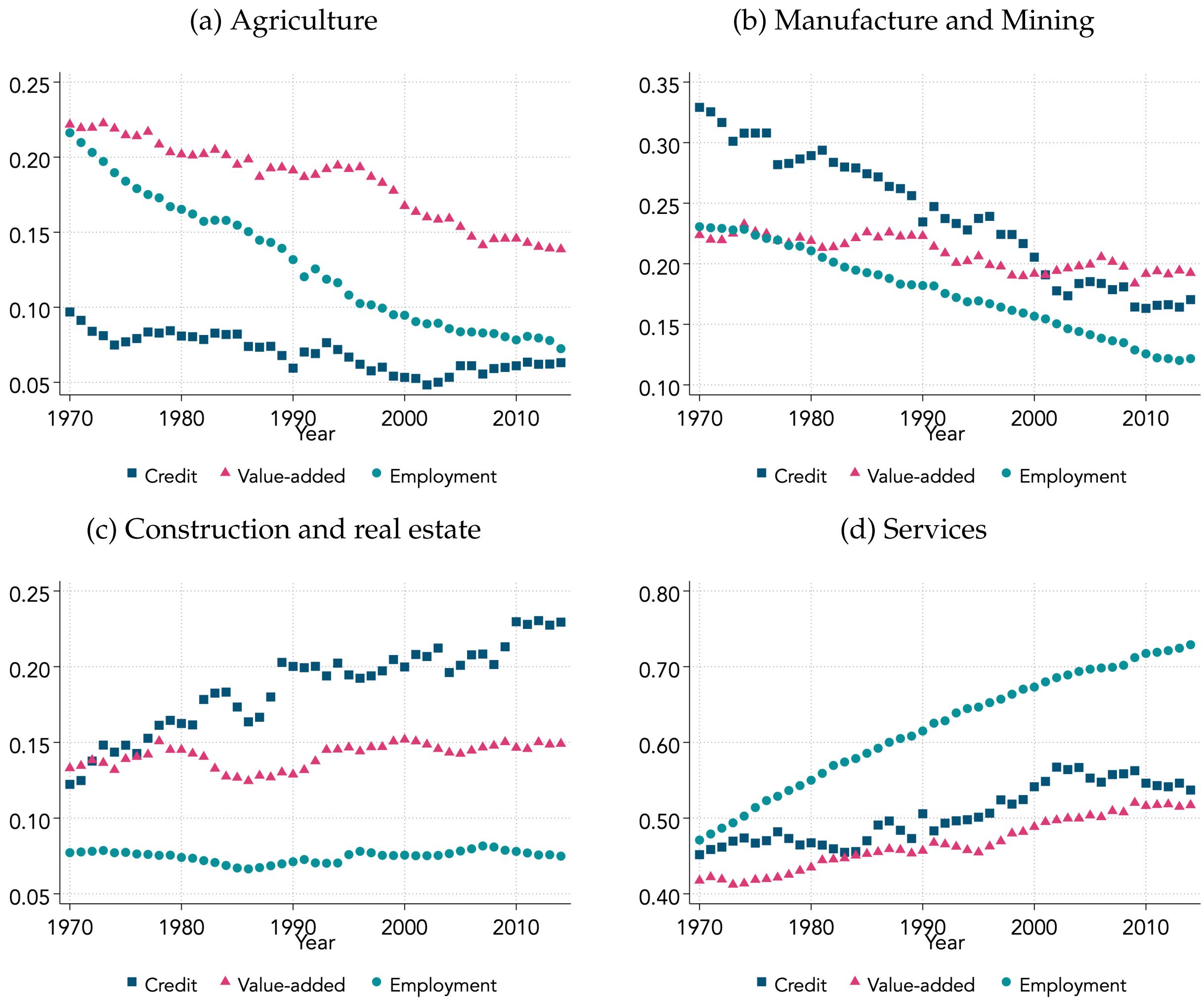
Next, we set λ^M to λ^E by income group, according to 8a without change the sectoral collateral share α^j, plotted in orange line with squares. As before, the change in collateral constraint does not quantitatively affect relative housing price in Figure D.10c compared to the baseline results, and thus have almost no impact on real-economy structural change as Figure D.10b. The counterfactual manufacture leverage significantly reduces in Figure D.10d, leading to credit reallocation towards construction as Figure D.10a.

Lastly, we shut down both channels, as the purple line with cross marks. Since both α^j and λ^j are set equal, there is no difference in sectoral leverage ratio, following Proposition 3. As expected, the results lie between the previous two experiments. As shown in Figure D.10b and D.10c, the result is quantitatively closer to Experiment 3, since variation in α^j is quantitatively more important to drive the housing price and real-economy structural change relative to change in λ^j. Quantitatively, for for this counterfactual scenario, the construction credit share is close to what we observe in the data, despite of less variation across income groups.

Taking stock, these counterfactual experiments indicate that sectoral heterogeneity in collateral share and collateral constraint is quantitatively important to *jointly* match observed financial and canonical Kuznets facts.

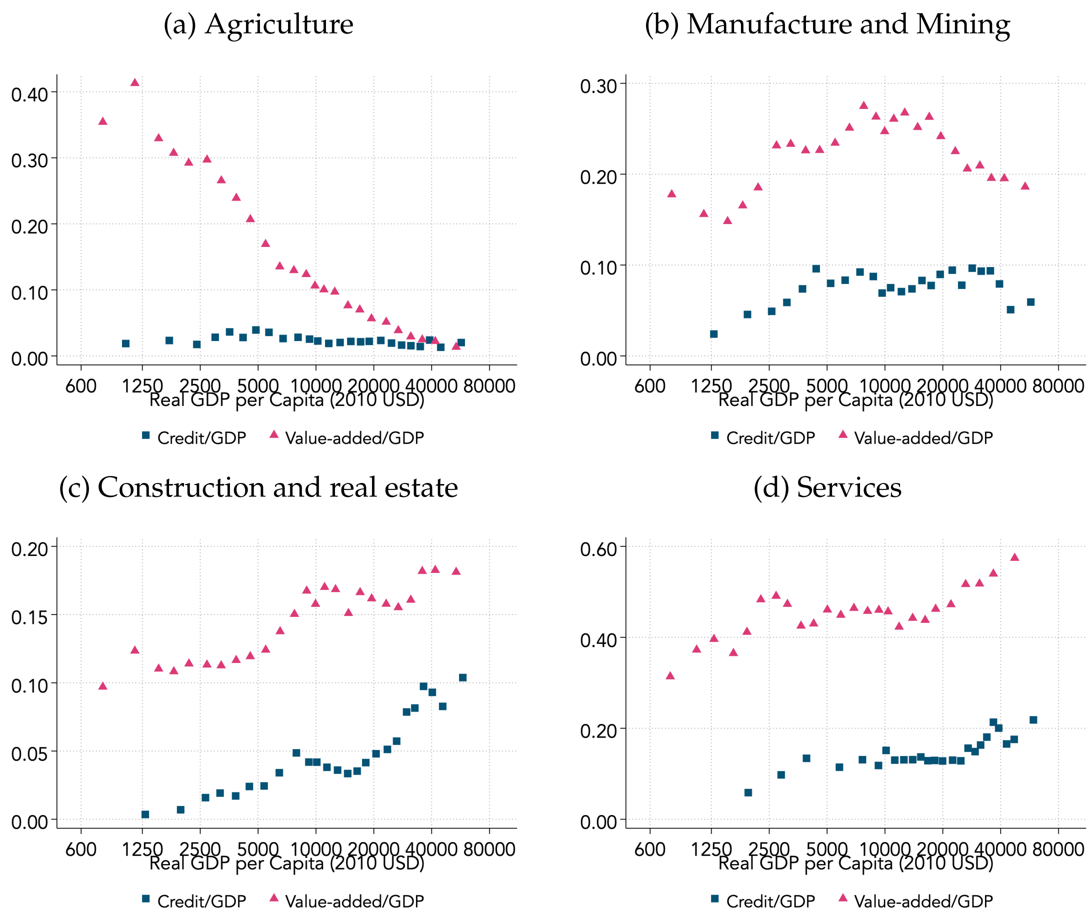
D Supplementary Figures

Figure D.1: Credit, Value-added, and Employment Shares: Time Series



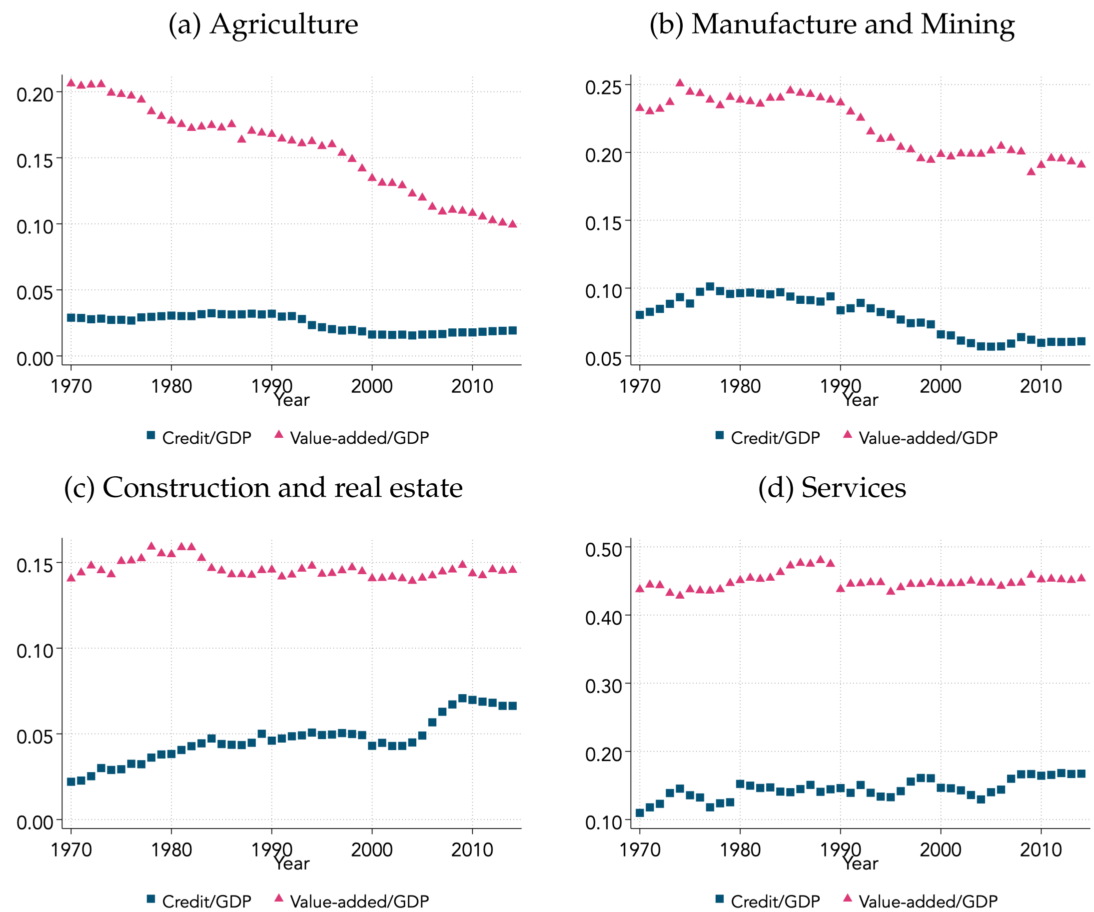
Note: This figure shows the times series of financial and real-economy structural transformation during the process of economic development, measured by the average of each variable within a particular year over different countries. We restrict the sample with non-missing credit, value-added, and employment data for all of these four sectors.

Figure D.2: Credit-to-GDP, VA-to-GDP and Development: Cross-Sectional Evidence



Note: This figure shows the dynamics of sectoral credit-to-GDP, VA-to-GDP through the process of economic development. Left panels are the binscatter plots for cross-sectional data with with logged real GDP per capita. Right panels are time series data, measured by the average of each variable within a particular year over different countries. We restrict the sample with non-missing credit, value-added, and employment data for all of these four sectors.

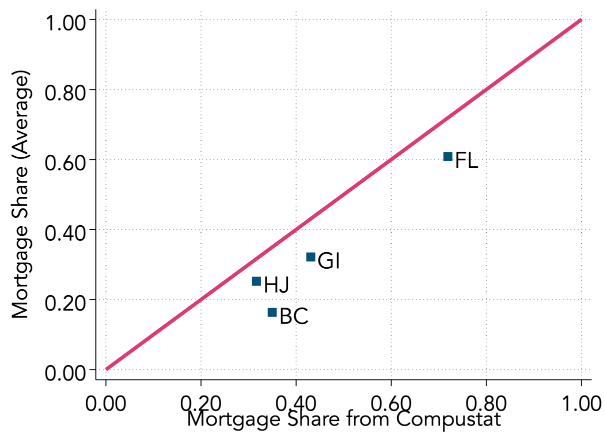
Figure D.3: Credit-to-GDP, VA-to-GDP and Development: Time Series Evidence



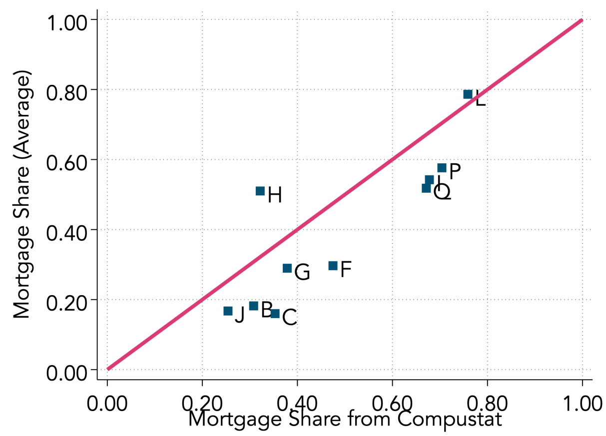
Note: This figure shows the dynamics of sectoral credit-to-GDP, VA-to-GDP through the process of economic development. Left panels are the binscatter plots for cross-sectional data with with logged real GDP per capita. Right panels are time series data, measured by the average of each variable within a particular year over different countries. We restrict the sample with non-missing credit, value-added, and employment data for all of these four sectors.

Figure D.4: Comparison of Mortgage Share: Compustat vs Country Average

(a) Broad Industries



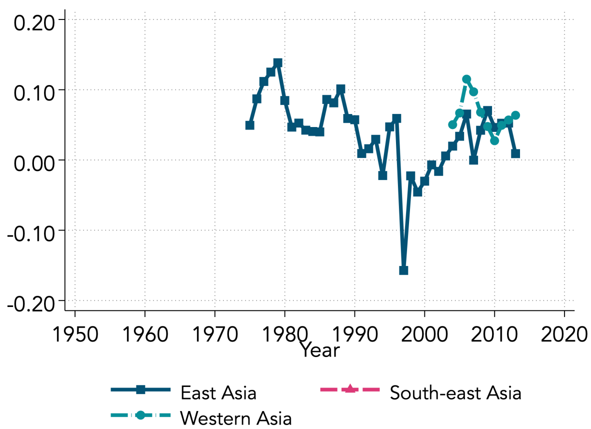
(b) 1 Digit Industries



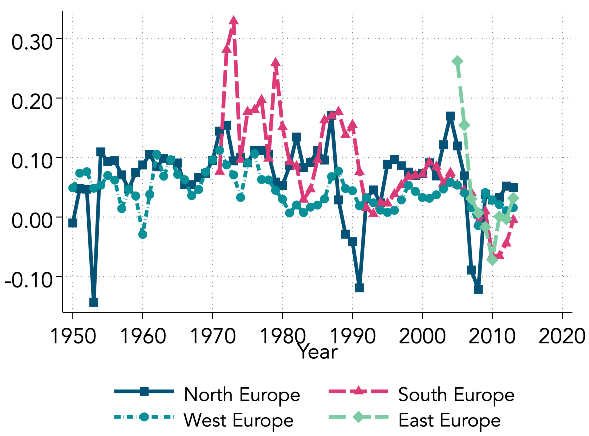
Notes: This figures compare the industry or sector level mortgage share in Compustat and calculated from country-average. Each dots represent a broad sector in Panel (a) and a 1-digit industry in Panel (b). The horizontal axis represents the mortgage share averaged from 5 countries, and the vertical axis represents that computed from Compustat.

Figure D.5: Log Change of Housing Price Index Across Subregions

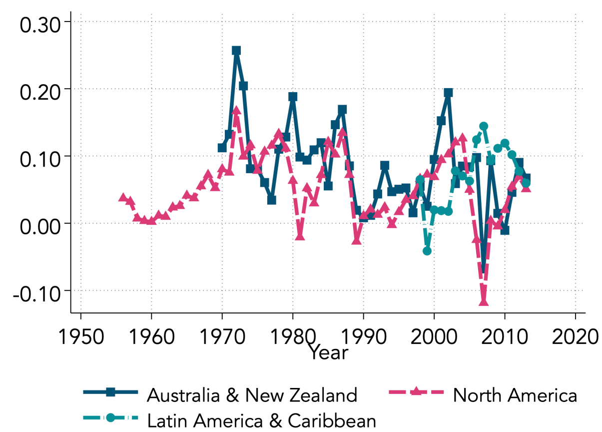
(a) Asia



(b) Europe

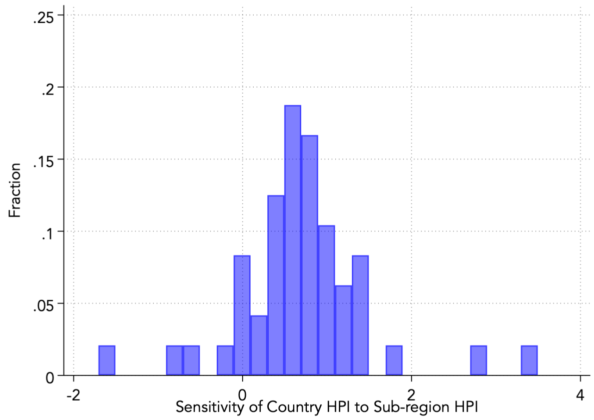


(c) Americas and Oceania



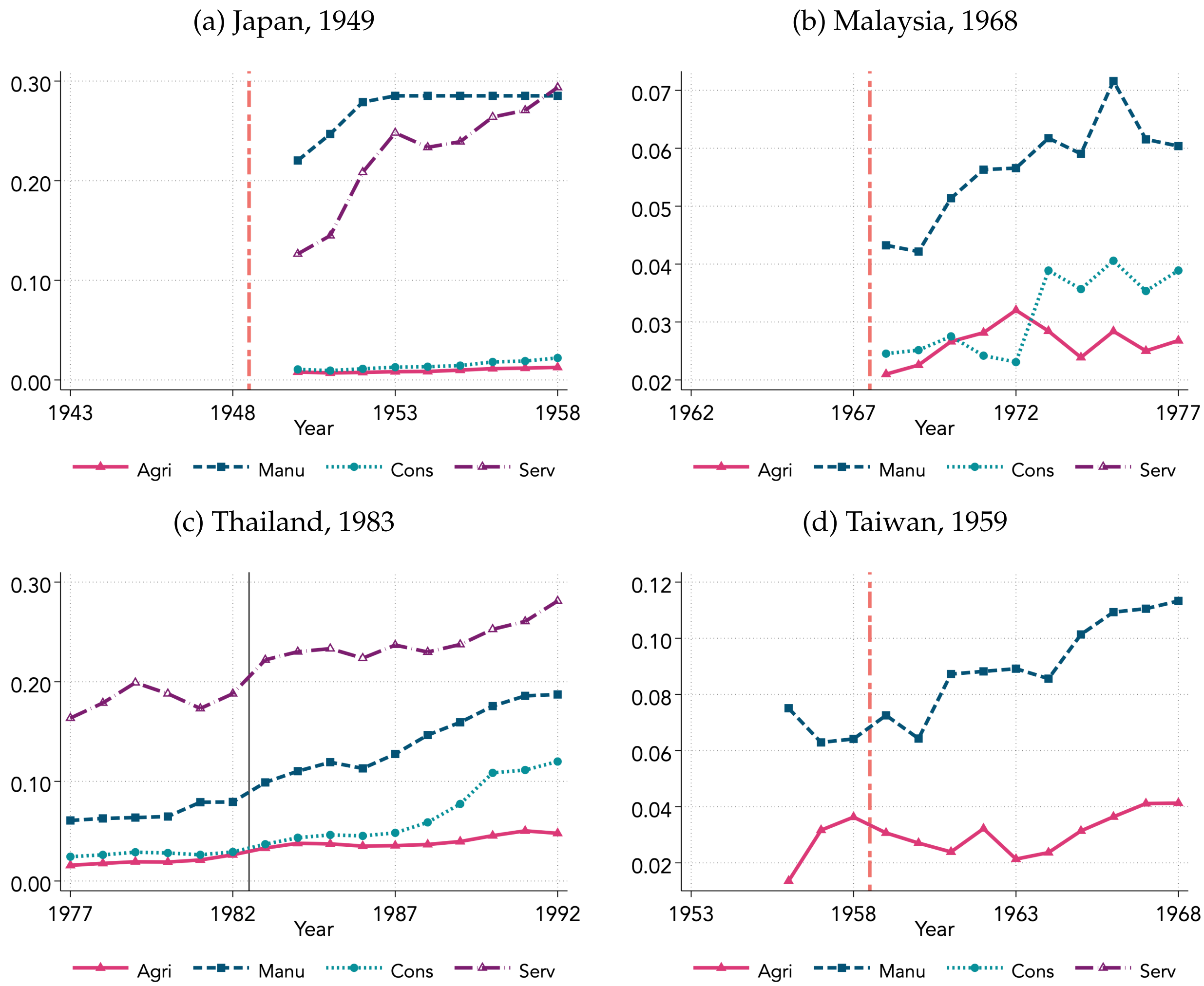
Note: This figure plots the housing price index over time at the sub-region level. We divide the countries into 10 subregions: Eastern/South-eastern/Western Aisa, Northern/Southern/Western/Eastern Europe, Australia and New Zealand, and Northern/Southern America. Since the data availability of housing price across countries increase over time, we adjust these breaks. For example, if there is a change of number of countries with valid housing price index at year t, we takes the change at year t as the average of change at $t-1$ and $t+1$.

Figure D.6: Distribution of Estimated Sensitivity $\widehat{\vartheta}_c$



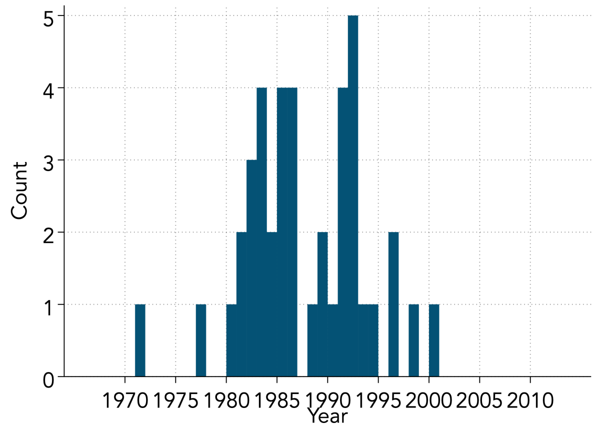
Note: This figure presents the distribution of estimated sensitivity of country level housing price index on that regional housing price index in a 1 year time-window from specification

Figure D.7: Credit Allocation During East Asian Growth Miracles: Robustness Check



Note: This figure shows the credit-to-GDP ratio across sectors following during the period of east Asian growth miracles. The timing for economic reform comes from Buera and Shin (2013), which is marked as a vertical line in the figure.

Figure D.8: Timing of Credit Liberalization

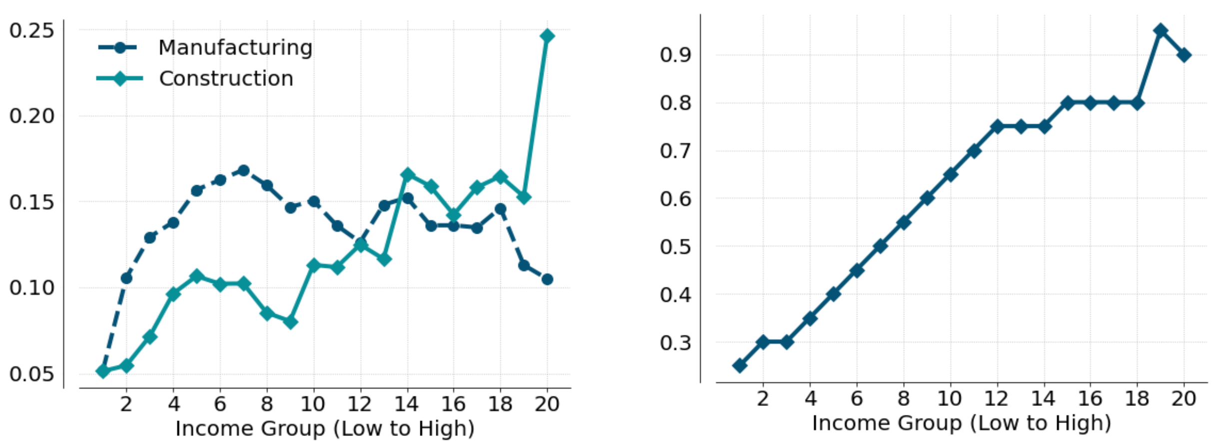


Note: This figure shows the count of credit liberalizations across countries by year.

Figure D.9: Calibrated Parameters of the Model: Adding Capital as Tangible Assets

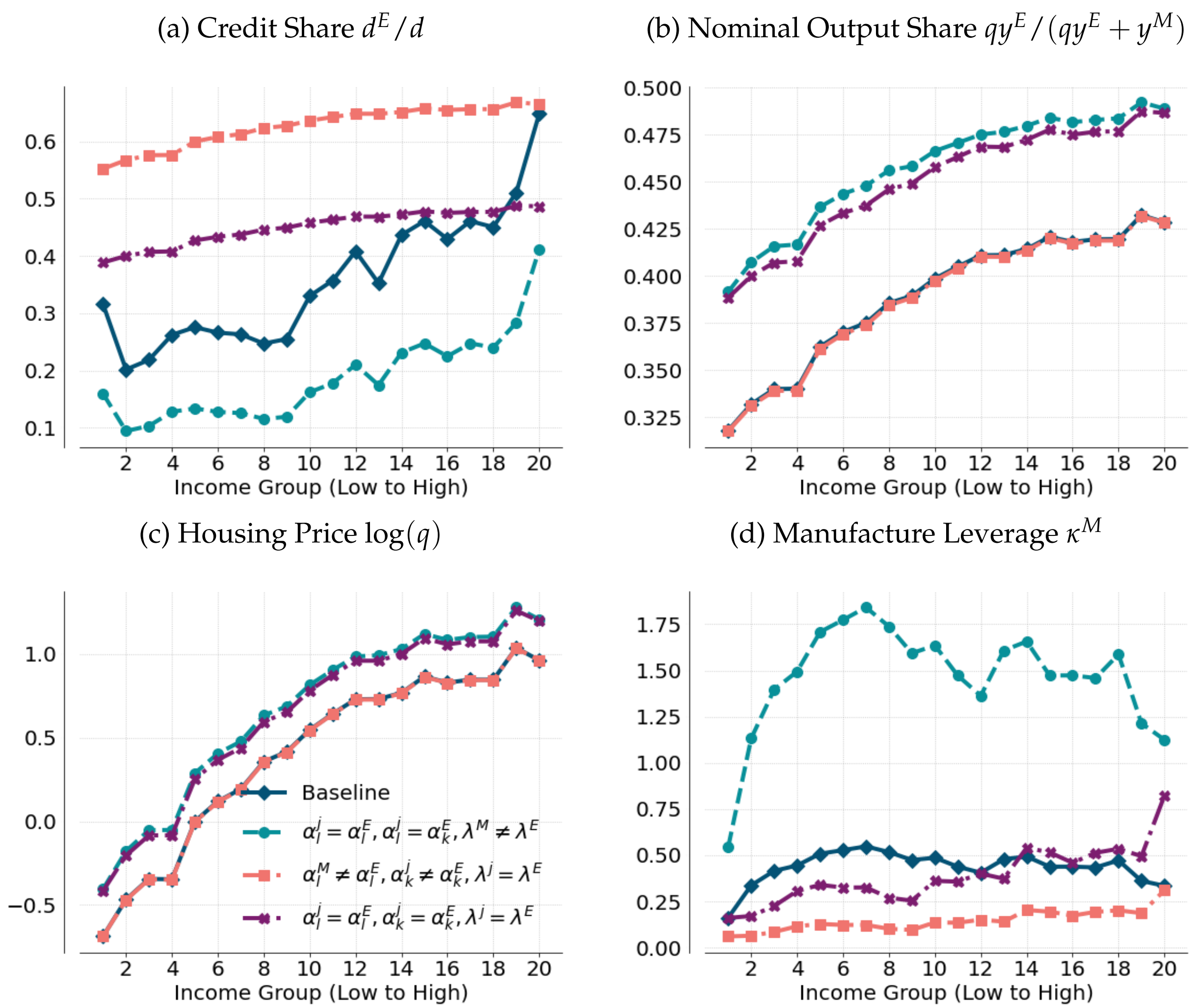
(a) Sectoral Collateral Constraint $\{\lambda_n^j\}_{n=1}^N$

(b) Sectoral TFP $\{z_n^M\}_{n=1}^N$



Note: This figure shows the key parameters governing the sectoral collateral constraints and TFP in the quantitative model.

Figure D.10: Counterfactual for Sectoral Heterogeneity



Note: This figure shows the results for counterfactual analysis for financial and canonical Kuznets facts, measured by construction/real estate credit share in Panel (a) and nominal output share in Panel (b), relative housing price in Panel (c) and manufacture/mining leverage, respectively. The blue line is the baseline calibrated result from Figure 9. The green dashed line fixes $\alpha^j = \alpha^E$ but vary λ^M and λ^E as Figure 8a. The orange dotted line fixes both λ^j to λ^E obtained for each income group from Figure 8a but varying α^j. The purple line shut down both channels.

E Supplementary Tables

Table E.1: Credit Share and Logged GDP Per Capita

	Panel A: Agriculture					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	-0.018***	-0.100***	-0.044***	0.126***	-0.013***	-0.186***
	(0.0017)	(0.0320)	(0.0020)	(0.0294)	(0.0017)	(0.0311)
ln(Real GDP per Capita)^2		0.004**		-0.009***		0.009***
		(0.0017)		(0.0015)		(0.0017)
Observations	1,857	1,857	1,857	1,857	1,857	1,857
# Countries	77	77	77	77	77	77
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.05	0.06	0.82	0.82	0.16	0.17
	Panel B: Manufacture & Mining					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	-0.043***	0.307***	-0.134***	1.139***	-0.032***	0.134**
	(0.0031)	(0.0562)	(0.0046)	(0.0611)	(0.0029)	(0.0532)
ln(Real GDP per Capita)^2		-0.019***		-0.066***		-0.009***
		(0.0030)		(0.0032)		(0.0028)
Observations	1,857	1,857	1,857	1,857	1,857	1,857
# Countries	77	77	77	77	77	77
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.09	0.11	0.71	0.77	0.26	0.26
	Panel C: Construction & Real Estate					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.058***	-0.246***	0.122***	-0.611***	0.054***	-0.174***
	(0.0027)	(0.0488)	(0.0041)	(0.0592)	(0.0027)	(0.0493)
ln(Real GDP per Capita)^2		0.016***		0.038***		0.012***
		(0.0026)		(0.0031)		(0.0026)
Observations	1,857	1,857	1,857	1,857	1,857	1,857
# Countries	77	77	77	77	77	77
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.20	0.22	0.73	0.75	0.25	0.26
	Panel D: Service					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.002	0.042	0.057***	-0.648***	-0.009**	0.229***
	(0.0035)	(0.0646)	(0.0058)	(0.0847)	(0.0034)	(0.0617)
ln(Real GDP per Capita)^2		-0.002		0.037***		-0.013***
		(0.0034)		(0.0044)		(0.0033)
Observations	1,857	1,857	1,857	1,857	1,857	1,857
# Countries	77	77	77	77	77	77
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.00	0.00	0.61	0.62	0.15	0.15

Notes: This table presents the estimation result for

$$\Delta_h \log(\text{Credit Share}^j_{c,t}) = \beta^j_0 + \beta^j_1 \log(\text{real GDP per Capita}_{c,t}) + \beta^j_2 \log(\text{real GDP per Capita}_{c,t})^2 + \gamma_c + \mu_t + \epsilon^j_{c,t,h},$$

where c, j and t indicate country, sector and year, respectively. γ_c is the country fixed effect, μ_t is year fixed effect. *, **, and *** denote significance at the 10%, 5% and 1% level.

Table E.2: Constant Price Value-Added Share and Logged GDP Per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Agriculture						
ln(Real GDP per Capita)	-0.103***	-0.408***	-0.059***	-0.408***	-0.103***	-0.380***
	(0.0012)	(0.0168)	(0.0018)	(0.0168)	(0.0012)	(0.0172)
ln(Real GDP per Capita)^2		0.017***		0.019***		0.016***
		(0.0009)		(0.0009)		(0.0010)
Observations	3,939	3,939	3,938	3,938	3,939	3,939
# Countries	96	96	95	95	96	96
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.67	0.69	0.93	0.93	0.68	0.70
Panel B: Manufacture & Mining	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.009***	0.448***	0.008***	0.196***	0.009***	0.457***
	(0.0013)	(0.0190)	(0.0020)	(0.0194)	(0.0014)	(0.0197)
ln(Real GDP per Capita)^2		-0.025***		-0.010***		-0.025***
		(0.0011)		(0.0011)		(0.0011)
Observations	3,939	3,939	3,938	3,938	3,939	3,939
# Countries	96	96	95	95	96	96
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.01	0.13	0.80	0.80	0.02	0.13
Panel C: Construction & Real Estate	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.019***	0.034**	-0.002	0.300***	0.020***	0.003
	(0.0010)	(0.0146)	(0.0021)	(0.0197)	(0.0010)	(0.0148)
ln(Real GDP per Capita)^2		-0.001		-0.017***		0.001
		(0.0008)		(0.0011)		(0.0008)
Observations	3,939	3,939	3,938	3,938	3,939	3,939
# Countries	96	96	95	95	96	96
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.09	0.09	0.61	0.64	0.12	0.13
Panel D: Service	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.076***	-0.078***	0.053***	-0.099***	0.075***	-0.084***
	(0.0014)	(0.0216)	(0.0030)	(0.0292)	(0.0014)	(0.0221)
ln(Real GDP per Capita)^2		0.009***		0.008***		0.009***
		(0.0012)		(0.0016)		(0.0013)
Observations	3,939	3,939	3,938	3,938	3,939	3,939
# Countries	96	96	95	95	96	96
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.41	0.42	0.77	0.77	0.43	0.43

Notes: This table presents the estimation result for

$$\Delta_h \log(\text{Value-Added Share}^j_{c,t}) = \beta^j_0 + \beta^j_1 \log(\text{real GDP per Capita}_{c,t}) + \beta^j_2 \log(\text{real GDP per Capita}_{c,t})^2 + \gamma_c + \mu_t + \epsilon^j_{c,t,h},$$

where c, j and t indicate country, sector and year, respectively. γ_c is the country fixed effect, μ_t is year fixed effect. *, **, and *** denote significance at the 10%, 5% and 1% level.

Table E.3: Nominal Price Value-Added Share and Logged GDP Per Capita

	Panel A: Agriculture					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	-0.101***	-0.265***	-0.101***	-0.261***	-0.100***	-0.272***
	(0.0012)	(0.0181)	(0.0024)	(0.0223)	(0.0012)	(0.0183)
ln(Real GDP per Capita)^2		0.009***		0.009***		0.010***
		(0.0010)		(0.0012)		(0.0010)
Observations	3,591	3,591	3,591	3,591	3,591	3,591
# Countries	89	89	89	89	89	89
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.66	0.67	0.90	0.90	0.67	0.67
	Panel B: Manufacture & Mining					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.026***	0.364***	-0.018***	0.524***	0.027***	0.349***
	(0.0014)	(0.0209)	(0.0030)	(0.0264)	(0.0014)	(0.0211)
ln(Real GDP per Capita)^2		-0.019***		-0.030***		-0.018***
		(0.0012)		(0.0015)		(0.0012)
Observations	3,591	3,591	3,591	3,591	3,591	3,591
# Countries	89	89	89	89	89	89
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.08	0.15	0.70	0.73	0.11	0.16
	Panel C: Construction & Real Estate					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.017***	-0.015	0.037***	0.091***	0.017***	-0.012
	(0.0008)	(0.0123)	(0.0020)	(0.0192)	(0.0008)	(0.0125)
ln(Real GDP per Capita)^2		0.002***		-0.003***		0.002**
		(0.0007)		(0.0011)		(0.0007)
Observations	3,591	3,591	3,591	3,591	3,591	3,591
# Countries	89	89	89	89	89	89
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.11	0.11	0.57	0.57	0.12	0.13
	Panel D: Service					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Real GDP per Capita)	0.058***	-0.081***	0.081***	-0.351***	0.055***	-0.062**
	(0.0016)	(0.0242)	(0.0037)	(0.0339)	(0.0016)	(0.0242)
ln(Real GDP per Capita)^2		0.008***		0.024***		0.007***
		(0.0014)		(0.0019)		(0.0014)
Observations	3,591	3,591	3,591	3,591	3,591	3,591
# Countries	89	89	89	89	89	89
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.27	0.27	0.70	0.72	0.30	0.31

Notes: This table presents the estimation result for

$$\Delta_h \log(\text{Value-Added Share}^j_{c,t}) = \beta^j_0 + \beta^j_1 \log(\text{real GDP per Capita}_{c,t}) + \beta^j_2 \log(\text{real GDP per Capita}_{c,t})^2 + \gamma_c + \mu_t + \epsilon^j_{c,t,h},$$

where c, j and t indicate country, sector and year, respectively. γ_c is the country fixed effect, μ_t is year fixed effect. *, **, and *** denote significance at the 10%, 5% and 1% level.

Table E.4: Employment Share and Logged GDP Per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Agriculture						
ln(Real GDP per Capita)	-0.178***	0.050	-0.184***	-0.325***	-0.175***	0.067
	(0.0025)	(0.0444)	(0.0034)	(0.0285)	(0.0026)	(0.0450)
ln(Real GDP per Capita)^2		-0.013***		0.008***		-0.013***
		(0.0024)		(0.0016)		(0.0025)
Observations	1,221	1,221	1,216	1,216	1,221	1,221
# Countries	55	55	50	50	55	55
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.81	0.81	0.97	0.98	0.82	0.82
Panel B: Manufacture & Mining						
ln(Real GDP per Capita)	0.032***	0.286***	-0.027***	0.645***	0.031***	0.263***
	(0.0014)	(0.0242)	(0.0033)	(0.0199)	(0.0013)	(0.0222)
ln(Real GDP per Capita)^2		-0.014***		-0.037***		-0.013***
		(0.0013)		(0.0011)		(0.0012)
Observations	1,221	1,221	1,216	1,216	1,221	1,221
# Countries	55	55	50	50	55	55
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.30	0.36	0.73	0.86	0.46	0.51
Panel C: Construction & Real Estate						
ln(Real GDP per Capita)	0.016***	0.100***	0.026***	0.142***	0.016***	0.097***
	(0.0006)	(0.0097)	(0.0012)	(0.0092)	(0.0006)	(0.0099)
ln(Real GDP per Capita)^2		-0.005***		-0.006***		-0.004***
		(0.0005)		(0.0005)		(0.0005)
Observations	1,221	1,221	1,216	1,216	1,221	1,221
# Countries	55	55	50	50	55	55
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.41	0.44	0.82	0.84	0.44	0.48
Panel D: Service						
ln(Real GDP per Capita)	0.129***	-0.441***	0.186***	-0.469***	0.129***	-0.430***
	(0.0024)	(0.0395)	(0.0040)	(0.0282)	(0.0023)	(0.0378)
ln(Real GDP per Capita)^2		0.031***		0.036***		0.031***
		(0.0022)		(0.0016)		(0.0021)
Observations	1,221	1,221	1,216	1,216	1,221	1,221
# Countries	55	55	50	50	55	55
Country FE			✓	✓		
Year FE					✓	✓
R^2	0.71	0.75	0.94	0.96	0.75	0.79

Notes: This table presents the estimation result for

$$\Delta_h \log(\text{Employment Share}^j_{c,t}) = \beta^j_0 + \beta^j_1 \log(\text{real GDP per Capita}_{c,t}) + \beta^j_2 \log(\text{real GDP per Capita}_{c,t})^2 + \gamma_c + \mu_t + \epsilon^j_{c,t,h},$$

where c, j and t indicate country, sector and year, respectively. γ_c is the country fixed effect, μ_t is year fixed effect. *, **, and *** denote significance at the 10%, 5% and 1% level.

Table E.5: Growth Implication of Sectoral Credit Allocation

	Panel A: Agriculture							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Share$^{Agri}_{c,t}$	0.13*	0.40***	0.077	-0.049	0.079	0.54**	-0.11	0.16
	(0.076)	(0.15)	(0.10)	(0.10)	(0.067)	(0.21)	(0.14)	(0.16)
Observations	1,938	1,937	1,937	1,012	1,509	1,506	1,506	758
# Countries	92	91	91	53	87	84	84	48
Country FE		✓	✓	✓		✓	✓	✓
Year FE			✓	✓			✓	✓
Other Controls				✓				✓
R^2	0.01	0.02	0.00	0.21	0.00	0.01	0.00	0.24
	Panel B: Manufacture & Mining							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Share$^{Manu}_{c,t}$	0.20***	0.33***	0.20**	0.36***	0.21*	0.38**	0.23**	0.74***
	(0.072)	(0.12)	(0.078)	(0.12)	(0.11)	(0.17)	(0.10)	(0.14)
Observations	1,938	1,937	1,937	1,012	1,509	1,506	1,506	758
# Countries	92	91	91	53	87	84	84	48
Country FE		✓	✓	✓		✓	✓	✓
Year FE			✓	✓			✓	✓
Other Controls				✓				✓
R^2	0.03	0.04	0.01	0.25	0.02	0.02	0.01	0.30
	Panel C: Construction & Real Estate							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Share$^{Cons}_{c,t}$	-0.29***	-0.46***	-0.34***	-0.10	-0.48***	-0.71***	-0.61***	-0.22
	(0.065)	(0.11)	(0.094)	(0.11)	(0.084)	(0.14)	(0.17)	(0.18)
Observations	1,938	1,937	1,937	1,012	1,509	1,506	1,506	758
# Countries	92	91	91	53	87	84	84	48
Country FE		✓	✓	✓		✓	✓	✓
Year FE			✓	✓			✓	✓
Other Controls				✓				✓
R^2	0.04	0.08	0.04	0.22	0.04	0.08	0.05	0.23
	Panel D: Service							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Share$^{Serv}_{c,t}$	-0.042	0.016	0.084	-0.10	-0.010	0.051	0.20**	-0.29***
	(0.038)	(0.067)	(0.080)	(0.066)	(0.084)	(0.12)	(0.097)	(0.11)
Observations	1,938	1,937	1,937	1,012	1,509	1,506	1,506	758
# Countries	92	91	91	53	87	84	84	48
Country FE		✓	✓	✓		✓	✓	✓
Year FE			✓	✓			✓	✓
Other Controls				✓				✓
R^2	0.00	0.00	0.00	0.21	0.00	0.00	0.01	0.26

Notes: This table presents the estimation result for

$$\Delta_h \log(\text{real GDP per Capita}_{c,t}) = \beta_h^j \text{Credit Share}^j_{c,t} + \gamma_c + \mu_t + X^j_{c,t} + \epsilon^j_{c,t,h}, \quad h = 5, 10,$$

where Δ_h is the operator for change from t to $t+h$, j indicates sector, γ_c is the country fixed effect, μ_t is year fixed effect, $X^j_{c,t}$ is other other macroeconomic controls, including a second-order polynomial of logged real GDP per capita at time t and sectoral value-added share at time t. Driscoll and Kraay (1998) standard errors are in the parentheses with lag length ceiling($1.5 \times h$). *, **, and *** denote significance at the 10%, 5% and 1% level.

Table E.6: First Stage Regression Result of Housing Price IV

	$\Delta_h \log(\text{HPI}_{c,t})$			
	$h = 1$	$h = 3$	$h = 5$	$h = 10$
	(1)	(2)	(3)	(4)
${}_hZ_{c,t}$	0.98***	0.97***	0.98***	0.89***
	(0.096)	(0.12)	(0.12)	(0.17)
Observations	1,538	1,307	1,133	824
# Countries	53	42	36	26
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
R^2	0.27	0.30	0.37	0.63

Notes: This regression table reports the regression results for the first stage specification $\Delta_h \log(\text{HPI}_{c,t}) = \alpha^h + \beta^h \,{}_hZ_{c,t} + \chi_c + \psi_t + \epsilon^h_{c,t}$.

Table E.7: Housing Price Pass-through to Sectoral Credit: Bivariate Regressions

	Panel A: $\Delta_h \log(\text{Credit}^{\text{manu}}_{c,t})$							
	$h=1$		$h=3$		$h=5$		$h=10$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \log(\text{HPI}_{c,t})$	0.16	0.37	0.23	0.55	0.23	0.42	0.30	-0.18
	[0.11,0.22]	[0.23,0.50]	[0.18,0.28]	[0.31,0.79]	[0.19,0.27]	[0.22,0.62]	[0.23,0.37]	[-0.64,0.29]
Observations	813	736	728	574	651	477	489	283
# Countries	39	36	37	24	33	21	22	15
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Other Controls	✓	✓	✓	✓	✓	✓	✓	✓
IV Regression	0.75	0.72	0.80	0.73	0.84	0.80	0.82	0.70
	Panel B: $\Delta_h \log(\text{Credit}^{\text{cons}}_{c,t})$							
	$h=1$		$h=3$		$h=5$		$h=10$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \log(\text{HPI}_{c,t})$	0.40	0.45	0.53	0.68	0.54	0.62	0.52	0.24
	[0.30,0.50]	[0.20,0.70]	[0.41,0.64]	[0.081,1.29]	[0.43,0.64]	[0.075,1.16]	[0.31,0.73]	[-0.39,0.86]
Observations	777	704	692	541	615	446	458	262
# Countries	39	36	37	23	32	20	21	15
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Other Controls	✓	✓	✓	✓	✓	✓	✓	✓
IV Regression	0.80	0.80	0.84	0.83	0.86	0.83	0.82	0.79

Notes: This table reports the estimation result for housing price pass-through to sectoral credit in different time horizons.

Table E.8: Cross-Sectional Evidence of Housing Price Pass-through

	Panel A: Manuf./Mining			Panel B: Cons/RE		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\text{HPI}_{c,t})$	0.27	0.12	0.34	0.72	0.25	0.38
	[0.13,0.41]	[-0.077,0.33]	[0.14,0.54]	[0.44,1.00]	[-0.018,0.51]	[0.23,0.53]
Observations	1,260	1,260	877	1,255	1,255	842
# Countries	50	50	39	50	50	39
Country FE	✓	✓	✓	✓	✓	✓
Year FE		✓	✓		✓	✓
Other Controls			✓			✓
R^2	0.98	0.99	1.00	0.95	0.97	0.99

	Panel C: Low Mortgage Share			Panel D: High Mortgage Share		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\text{HPI}_{c,t})$	0.40	0.12	0.12	0.49	0.19	0.18
	[0.20,0.61]	[-0.14,0.38]	[-0.15,0.39]	[0.27,0.71]	[-0.12,0.50]	[-0.13,0.48]
Observations	3,591	3,591	3,591	2,555	2,555	2,555
# Countries	50	50	50	52	52	52
# Industries	3	3	3	2	2	2
Country FE	✓	✓	✓	✓	✓	✓
Year FE		✓			✓	
Industry FE	✓	✓		✓	✓	
Industry×Year FE			✓			✓
R^2	0.96	0.97	0.97	0.90	0.91	0.92

Notes: This table reports the cross-sectional evidence of housing price pass-through to credit in different sectors or industries with high/low mortgage share. Panel A and B estimate

$$\log(\text{credit}^j_{c,t}) = \beta^j \log(\text{HPI})_{c,t} + X^j_{c,t} + \mu_c + \gamma_t + e^j_{c,t}$$

where j is sector, either manufacture/mining or construction/real estate, c indicates country, t indicates year. Panel C and D estimate

$$\log(\text{credit}^\kappa_{c,t,j}) = \beta^\kappa \log(\text{HPI})_{c,t} + \mu_c + \gamma_t + \varrho_j + e^\kappa_{c,t,j}$$

where κ indicates whether the industry has low or high mortgage share, ϱ_j is the industry fixed effect. We separate the high and low mortgage share industry using a threshold of 45%. By definition, $\widehat{\beta}^j$ and $\widehat{\beta}^\kappa$ are the coefficients of interest. Standard errors are clustered at the country level. 95% confidence intervals are in the bracket.

Table E.9: Credit Growth and Collateral Usage: Country and Industry Variation

	$\Delta_h \log(\text{Credit}_{c,j,t})$			
	$h = 5$		$h = 10$	
	(1)	(2)	(3)	(4)
Mortgage $\text{Share}_{c,j}$	1.33^{***}	0.60^{**}	2.78^{***}	1.20^{**}
	(0.26)	(0.24)	(0.40)	(0.59)
Observations	280	350	185	191
# Countries	4	4	4	4
# Industries	5	9	5	8
Country×Year FE	✓	✓	✓	✓
Industry×Year FE	✓	✓	✓	✓
Industry Level	Broad	1-Digit	Broad	1-Digit
Mean of Dependent Var.	0.16	0.20	0.32	0.45
R^2	0.89	0.81	0.90	0.71

Notes: This table reports the relation between mortgage share and growth of credit for 5-year or 10-year time horizon following the specification in a country-year-industry panel

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta_h \text{Mortgage Share}_{c,j} + \text{Fixed Effects} + \epsilon_{c,j,t} \text{ for } h = 3, 5, 10.$$

*, ** and *** denote significant at the 10%, 5% and 1% level. We use nominal credit on the dependent variable since price level is controlled by industry × year fixed effects.

Table E.10: Credit Growth and Collateral Usage: Industry Variation

	Panel A: Sectoral Credit Growth and Mortgage Share							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mortgage Share$_j$	0.11***	0.11***	0.22***	0.21***	0.27***	0.28***	0.42***	0.45***
	(0.030)	(0.023)	(0.034)	(0.029)	(0.044)	(0.034)	(0.052)	(0.045)
Observations	14,516	15,520	16,046	16,858	11,868	12,752	12,796	13,493
# Countries	111	112	111	109	105	110	105	107
# Industries	5	5	9	9	5	5	9	9
Country FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Country×Year FE		✓		✓		✓		✓
Industry Level	Broad	Broad	1-Digit	1-Digit	Broad	Broad	1-Digit	1-Digit
Mean of Dependent Var.	0.30	0.30	0.29	0.29	0.58	0.58	0.56	0.56
R^2	0.20	0.75	0.16	0.66	0.30	0.85	0.25	0.79
	Panel B: Sectoral Credit Growth and Real Estate Input Share							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Real Estate Input Share$_j$	0.65***	0.62***	1.55**	1.80***	1.42***	1.35***	3.31***	3.80***
	(0.056)	(0.045)	(0.77)	(0.68)	(0.082)	(0.066)	(1.07)	(0.94)
Observations	16,476	17,650	8,084	7,942	13,415	14,448	6,607	6,473
# Countries	111	112	111	100	105	110	105	95
# Industries	6	6	3	3	6	6	3	3
Country FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Country×Year FE		✓		✓		✓		✓
Industry Level	Broad	Broad	1-Digit	1-Digit	Broad	Broad	1-Digit	1-Digit
Mean of Dependent Var.	0.31	0.31	0.23	0.23	0.60	0.60	0.43	0.42
R^2	0.17	0.66	0.19	0.71	0.28	0.80	0.32	0.84

Notes: This table reports the relation between mortgage share and growth of credit for 5-year or 10-year time horizon following the specification in a country-year-industry panel

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta_h \text{Collateral Usage}_{c,j} + \text{Fixed Effects} + \epsilon_{c,j,t} \text{ for } h = 3, 5, 10.$$

*, ** and *** denote significant at the 10%, 5% and 1% level. Panel A and B use mortgage share and real estate input share as the measure for sector-specific collateral usage. Country × year fixed effects captures the country-year specific price index. For these columns, the dependent variable is logged sectoral credit which is more available. For columns with country and year fixed effects, the dependent variable is logged sectoral real credit, deflated by CPI.

Table E.11: Credit Growth and Collateral Usage: Country Variation

	Panel A: Mortgage to GDP Ratio							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \left(\frac{\text{Mortgage}}{\text{GDP}}\right)_{c,t}$	1.51***	1.50***	1.68***	1.63***	1.22***	1.21***	1.55***	1.49***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)	(0.11)	(0.11)	(0.11)
Observations	4,683	4,683	4,875	4,823	3,741	3,741	3,793	3,744
# Countries	35	35	35	35	30	30	30	30
# Industries	6	6	9	9	6	6	9	9
Industry FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry×Year FE		✓		✓		✓		✓
Industry Level	Broad	Broad	1-Digit	1-Digit	Broad	Broad	1-Digit	1-Digit
Mean of Dependent Var.	0.25	0.25	0.23	0.23	0.48	0.48	0.47	0.46
R^2	0.16	0.22	0.19	0.26	0.17	0.22	0.21	0.27
	Panel B: Household Residential Mortgage to GDP							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \left(\frac{\text{HH Resid Mortgage}}{\text{GDP}}\right)_{c,t}$	1.21***	1.22***	1.95***	1.87***	0.89***	0.87***	1.40***	1.29***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Observations	7,538	7,537	8,027	8,011	5,720	5,719	5,921	5,899
# Countries	69	69	69	69	57	57	57	57
# Industries	6	6	9	9	6	6	9	9
Industry FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry×Year FE		✓		✓		✓		✓
Industry Level	Broad	Broad	1-Digit	1-Digit	Broad	Broad	1-Digit	1-Digit
Mean of Dependent Var.	0.28	0.28	0.25	0.25	0.52	0.52	0.48	0.48
R^2	0.09	0.14	0.10	0.17	0.10	0.14	0.11	0.18
	Panel C: Household Residential Mortgage to Household Credit							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \left(\frac{\text{HH Resid Mortgage}}{\text{HH Credit}}\right)_{c,t}$	0.41***	0.41***	0.44***	0.44***	0.65***	0.64***	0.56***	0.55***
	(0.071)	(0.071)	(0.069)	(0.070)	(0.080)	(0.081)	(0.077)	(0.078)
Observations	7,419	7,418	7,876	7,854	5,606	5,605	5,780	5,766
# Countries	69	69	69	69	57	57	57	57
# Industries	6	6	9	9	6	6	9	9
Industry FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry×Year FE		✓		✓		✓		✓
Industry Level	Broad	Broad	1-Digit	1-Digit	Broad	Broad	1-Digit	1-Digit
Mean of Dependent Var.	0.28	0.28	0.25	0.25	0.52	0.52	0.48	0.48
R^2	0.08	0.13	0.08	0.14	0.10	0.15	0.09	0.16

Notes: This table reports the relation between mortgage share and growth of credit for 5-year or 10-year time horizon following the specification in a country-year-industry panel

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta_h \Delta_h \text{Collateral Usage}_{c,t} + \text{Fixed Effects} + \epsilon_{c,j,t} \text{ for } h = 5, 10.$$

Panel A, B and C use mortgage to GDP ratio, household residential mortgage to GDP and household residential mortgage to household credit as measure of collateral usage, respectively. *, ** and *** denote significant at the 10%, 5% and 1% level.

Table E.12: Credit Growth and Change of Intangibles/Tangibles

	Panel A: Intangible Asset Share							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ_hIntangible Share$_{c,j,t}$	-2.06**	-2.79***	-2.83***	-2.46**	-2.50**	-3.54***	-3.84***	-3.93***
	(0.72)	(0.80)	(0.88)	(1.11)	(0.80)	(0.91)	(0.93)	(0.91)
Observations	1,567	1,191	1,551	1,190	825	651	811	650
# Countries	15	15	15	15	14	14	14	14
# Industries	18	11	18	11	17	11	16	11
Country×Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry×Year FE			✓	✓			✓	✓
R^2	.0098	.019	.017	.014	.025	.047	.055	.056

	Panel B: Intangibe and Tangible Assets							
	$h=5$				$h=10$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_h \log(\text{Intangible}_{c,j,t})$	0.40***	0.40***	0.10	0.18	0.46***	0.37***	0.13	0.17
	(0.087)	(0.088)	(0.17)	(0.17)	(0.038)	(0.047)	(0.16)	(0.17)
$\Delta_h \log(\text{Tangible}_{c,j,t})$	0.74***	0.82***	0.70***	0.61***	0.78***	0.97***	0.79***	0.81***
	(0.063)	(0.093)	(0.10)	(0.13)	(0.032)	(0.033)	(0.024)	(0.058)
Observations	1,567	1,191	1,551	1,190	825	651	811	650
# Countries	15	15	15	15	14	14	14	14
# Industries	18	11	18	11	17	11	16	11
Country×Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry×Year FE			✓	✓			✓	✓
R^2	.065	.089	.037	.039	.12	.15	.089	.099

Notes: This table reports the relation between change of intangible or tangible assets and industry credit growth in a country, year, 1-digit industry panel. This upper panel estimates the following specification

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta^h \Delta_h \text{Intangible Share}_{c,j,t} + \text{Fixed Effects} + \epsilon_{c,j,t} \text{ for } h = 5, 10.$$

The lower panel estimates the following specification

$$\Delta_h \log(\text{Credit}_{c,j,t}) = \beta^h_{\text{Intangible}} \Delta_h \log(\text{Intangible}_{c,j,t}) + \beta^h_{\text{Tangible}} \Delta_h \log(\text{Tangible}_{c,j,t}) + \text{Fixed Effects} + \epsilon_{c,j,t} \text{ for } h = 5, 10.$$

*, ** and *** denote significant at the 10%, 5% and 1% level.

Table E.13: Quantifying the Decomposition Rule: Baseline

Group Range	Variable	$\Delta\log(\mathbf{Q})$	$\Delta\log(\mathbf{Z})$	$\Delta\log(\mathbf{W})$	$\Delta\log(\mathbf{\Gamma})$	Total
1 to 20	$\Delta\log(d^E/d^M)$	1013.2%	-364.3%	-626.3%	77.4%	100.0%
1 to 20	$\Delta\log(qy^E/y^M)$	2950.1%	-1060.7%	-1823.4%	34.1%	100.0%
1 to 7	$\Delta\log(d^E/d^M)$	-2902.2%	1036.7%	1781.2%	184.3%	100.0%
1 to 7	$\Delta\log(qy^E/y^M)$	2959.0%	-1057.0%	-1816.0%	14.0%	100.0%
5 to 15	$\Delta\log(d^E/d^M)$	908.6%	-325.0%	-558.9%	75.3%	100.0%
5 to 15	$\Delta\log(qy^E/y^M)$	3001.1%	-1073.6%	-1846.0%	18.4%	100.0%

Note: This table shows how different channels contribute to financial and canonical Kuznets facts.

Table E.14: Quantifying the Decomposition Rule: Adding Capital as Tangible Assets

Group Range	Variable	$\Delta\log(\mathbf{Q})$	$\Delta\log(\mathbf{Z})$	$\Delta\log(\mathbf{W})$	$\Delta\log(\mathbf{\Gamma})$	Total
1 to 20	$\Delta\log(d^E/d^M)$	2105.6%	-2101.0%	0.0%	95.4%	100.0%
1 to 20	$\Delta\log(qy^E/y^M)$	7579.9%	-7563.5%	0.0%	83.6%	100.0%
1 to 7	$\Delta\log(d^E/d^M)$	-4320.5%	4224.3%	-0.0%	196.2%	100.0%
1 to 7	$\Delta\log(qy^E/y^M)$	7777.2%	-7604.0%	0.0%	-73.2%	100.0%
5 to 15	$\Delta\log(d^E/d^M)$	1809.9%	-1806.2%	0.0%	96.3%	100.0%
5 to 15	$\Delta\log(qy^E/y^M)$	7620.8%	-7605.2%	0.0%	84.5%	100.0%

Note: This table shows how different channels contribute to financial and canonical Kuznets facts.