

Research Statement

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1 Summary

Financial frictions are one of the major barriers to economic development. By limiting access to credit, they can prevent firms from adopting more advanced technologies, and hinder the reallocation of capital toward more productive projects. Despite the consensus on the importance of financial frictions, identifying their specific sources and documenting how they operate at the micro-level has proven challenging. My first area of research focuses on identifying and measuring specific institutional frictions that characterize credit markets in developing countries using micro data, and on documenting and quantifying their real effects on firms and individuals. I focus in particular on frictions that affect judicial institutions in charge of enforcing creditors' rights. These are critical for the functioning of credit markets but are often plagued by long delays, bias in the interpretation of the law and political influence.

The second area of my research focuses on how economies adjust to two major productivity shocks that have affected developing countries in the last decades: technological innovations in agriculture and climate change. A comprehensive understanding of the impact of these shocks requires the study of not just their direct effects on affected regions or sectors, but also how such shocks propagate across regions and sectors through capital and labor markets. My work contributes to the literature by studying this process of reallocation, and by documenting the role that financial institutions play in it.

My work is empirical but guided by economic theory. I use administrative micro-level data to answer general-interest macro-level questions. I build long-term collaborations with Central Banks and Statistical Institutes in developing economies, which allows me to access confidential dataset often not previously available to external researchers, establish new stylized facts, and keep a direct conversation with local experts. Whenever possible, I propose new empirical strategies exploiting plausibly exogenous sources of variation, with the objective of making causal statements.

The first area of my research studies the **institutional sources of financial frictions in developing countries and their real effects**. My main focus in this line of research is on judicial institutions in charge of enforcing creditors' rights. There is a consensus that introducing new laws that increase the legal protection of creditors should create a more favorable environment for lending and investment in developing countries. One example is the new bankruptcy laws recently introduced in Brazil, China and India. However, as my research documents, the judicial institutions in charge of enforcing such laws are seldom well-functioning in developing countries: cases linger for long periods due to congested courts ([7]), judges lack training and specialization ([3]), or display bias in judicial decisions favoring certain parties such as workers or government-connected firms

([1],[3]). My research uses micro-data to provide empirical measures of these frictions. Exploiting plausibly exogenous variation in the quality of local enforcement within countries, I document that otherwise desirable improvements in legal rules can prove ineffective in the absence of proper enforcement. While the law and finance literature had traditionally studied the role of legal reforms and quality of enforcement separately, my work emphasizes the importance of their interaction.

Another important friction in developing countries is the preferential access to finance granted to government-connected firms or individuals. This issue has become more prominent after the global financial crisis, when governments have increasingly become active in promoting credit expansions either directly or via government-controlled banks. My research studies the effects of these policies on the allocation of credit across firms in China ([6]) and across individuals in Brazil ([13]), as well as their implications for long-run growth. Overall, I document that government interventions in credit markets aimed at stimulating economic activity can have important unintended consequences – for example by leading to higher capital misallocation or by pushing less financially sophisticated individuals into overindebtedness. In related work, I explore the role of corruption in the allocation of government procurement contracts and its real effects on firm investment decisions ([2]).

My most recent work in this area studies information frictions, especially those created by language barriers which tend to be persistent over time. This is an important issue given the high levels of language and cultural fragmentation observed in many developing countries – including India and Sub Saharan Africa – where access to information has the potential to be more transformative. Despite its importance, this issue is often overlooked in the implementation of large government programs targeting the poor. Using micro-data from India, I document that language barriers significantly limit the impact of programs designed to provide information about new agricultural technologies to farmers ([14]) and of programs aimed at facilitating access to credit ([12]).

My second area of research studies the process of reallocation of resources across firms, sectors and regions that economies experience in response to major productivity shocks. A first strand of this research focuses on technological innovations in the agricultural sector. The experience of the first industrialized countries – like England – shows that technological innovations in agriculture can favor the development of industry and services by freeing up labor for other activities, increasing demand for manufactured goods and generating savings to finance industrial projects. However, this **structural transformation** process has not taken off in several developing countries when they adopted new agricultural technologies. Explanations proposed by the theoretical literature include openness to trade and market frictions that limit the reallocation of capital and labor across sectors. The literature offers scarce direct empirical evidence testing the mechanisms proposed by these models.

In three papers, I bridge theory and evidence by tracing the effects of recent agricultural technical innovations such as genetically engineered (GE) crops through detailed micro-data from Brazil. Two main insights emerge from this line of research. First, new agricultural technologies can foster industrialization in developing countries when such technologies are strongly labor-saving (i.e. they allow farmers to produce the same output with less labor per unit of land) as in the case of GE crops ([8]). However, this mechanism fosters a specific type of industrialization. Because workers released from agriculture are mostly unskilled, they tend to reallocate to the least skill-intensive and least-innovative industries, reinforcing their comparative advantage and reducing productivity growth in the long run ([17]). Second, I document the role of financial institutions in the process of structural transformation. The adoption of new agricultural technologies increases income and savings among land owners in rural areas. While there is limited migration of labor in response to these shocks, capital is more mobile. Exploiting micro-data on capital flows across regions and loan-level data, I find that banks redirect agricultural savings toward urban regions to finance firms in innovation-intensive manufacturing and services ([17],[4]), accentuating existing differences in productivity across regions.

More recently, my research in this area has focused on the reallocation of resources driven by **adaptation to climate change**. In particular, I study the role of financial institutions in the process of adaptation. Despite the fact that financial institutions shape how economies adapt to climate change via their lending decisions and their ability to reallocate capital across regions and sectors, there is scarce direct empirical evidence in the literature on their role.

Using micro-data from Brazil, I document that, in the short run, banks are willing to provide credit to regions experiencing weather shocks such as droughts. However, when changes in local climate are perceived as permanent, banks reallocate capital out of affected regions ([16]). Persistent droughts also generate major reallocation of labor. In regions affected by droughts, workers are displaced from agriculture and services. While local manufacturing can absorb some of the displaced workers, the majority of them out-migrate and – through personal connections – mostly find jobs in small firms outside of manufacturing in destination regions. In related work in progress, I explore to what extent financial institutions incorporate climate models’ predictions in their lending decisions using loan-level data from Mexico ([19]). Preliminary results show that climate models perform well in predicting future climatic conditions and default by agricultural firms at fine geographical level, but also that banks do not use this information when pricing new loans.

Another objective of my research in this area is to understand the heterogeneous ability of firms to adapt to new climatic conditions. Using micro-data from the US Census, I document that higher temperatures have strong negative effects on energy costs and productivity of small plants,

while large plants are largely unaffected ([15]). Over the long run, this has led to a reallocation of labor from small to large plants and higher local labor market concentration in US counties that experienced faster increases in temperatures.

2 Financial Frictions in Developing Countries

The first area of of my research studies financial frictions faced by firms in developing countries. By limiting access to external finance, such frictions can constrain firms' ability to invest and to adopt more advanced technologies (Banerjee and Duflo, 2005; World Bank, 2005). In addition, they can hinder the reallocation of capital toward more productive projects, decreasing aggregate productivity (Hsieh and Klenow, 2009, Banerjee and Moll, 2010, Buera et al., 2011 and Caselli and Gennaioli, 2013). My research focuses on three key sources of financial frictions: weak protection of creditors' rights due to poorly functioning judicial institutions, preferential access to finance granted to government-connected firms and individuals, and information frictions limiting access to credit and technology adoption.

2.1 Judicial Institutions

The first part of my work on financial frictions in developing countries has focused on the role of judicial institutions. My first paper in this line of research is “**Court Enforcement, Bank Loans and Firm Investment: Evidence from a Bankruptcy Reform in Brazil**” (Ponticelli and Alencar [7], *Quarterly Journal of Economics*, 2016). The objective of this paper is to study the extent to which the effects of a financial reform depend on the quality of the judicial institutions in charge of its enforcement. This is a critical question in developing countries that often introduce elaborate bankruptcy procedures inspired by the regulation in place in developed economies, which their courts can hardly enforce in the intended way.

In two seminal papers, La Porta et al. (1997, 1998) show that both the strength of legal rules on creditor protection and the quality of their enforcement promote larger and more developed capital markets. However, the literature that followed studied the role of legal rules and quality of enforcement either exploiting cross-country differences or focusing on these two channels separately. Our paper contributes to the literature by studying the interaction between legal reforms and quality of enforcement at the micro-level.

We focus our analysis on Brazil, which in 2005 undertook a major bankruptcy reform aimed at increasing secured creditors' chances of recovering their claims when a firm is liquidated. In addition, Brazilian judicial districts are highly heterogeneous in terms of efficiency. Crucially,

Brazilian laws do not allow creditors or firms to choose the district in which to file a bankruptcy case. Therefore, when the new bankruptcy law entered into force, the efficiency of local courts became a key determinant of the ability of both creditors and firms to reap the benefits of the reform.

We construct a new dataset on the congestion of Brazilian courts in charge of bankruptcy cases using monthly reports that judges and administrative staff submit to the National Justice Council (CNJ). We then combine data on congestion of civil courts across Brazilian municipalities with confidential data on bank loans from the Credit Information System of the Central Bank of Brazil and data on firm investment and productivity from a national manufacturing survey.

To establish the direction of causality, we use an instrumental variable strategy that exploits Brazilian state laws on judicial organization. These laws establish minimum requirements for municipalities to become independent judicial districts. For each Brazilian municipality that is seat of a judicial district, we construct a measure of potential extra-jurisdiction equal to the number of neighboring municipalities that do not meet the requirements, therefore increasing the workload of existing courts. Using potential extra-jurisdiction as an instrument for the congestion of courts dealing with bankruptcy cases, we document that firms operating in municipalities with less congested courts experienced a larger increase in the use of secured loans, as well as a larger increase in investment and value of output in the years after the reform.

These results indicate that financial reforms aimed at improving firms' access to external finance in developing countries can prove ineffective when judicial institutions are poorly functioning. Our findings also inform the debate on the sequencing of economic reforms (Caselli and Gennaioli, 2008), indicating that an efficient judiciary is a necessary precondition for firms to benefit from these reforms.

In a second paper in this line of research, “**The Labor Effects of Judicial Bias in Bankruptcy**” (Araujo, Ferreira, Lagaras, Moraes, Ponticelli, and Tsoutsoura [1], *Journal of Financial Economics*, 2023), we focus on another type of friction in the functioning of courts in developing countries: judicial bias in the interpretation of the law. A large literature in bankruptcy has studied the effects of judicial leniency on firm-level outcomes (Chang and Schoar, 2013; Bernstein et al., 2019) and individual-level outcomes (Dobbie et al., 2017; Doyle Jr, 2007). We make two contribution to this literature. First, despite the tendency to favor the continuation of insolvent firms (pro-continuation bias) is considered widespread among judges in developing countries, most of the literature has so far focused on this issue in the US, due to lack of detailed data in other contexts. Second, we investigate the effect of judicial bias on the labor market outcomes of the workers of bankrupt firms. This is an important outcome as pro-continuation bias by judges is often justified with the

objective of preserving employment.

We collect new data covering the universe of bankruptcy cases filed in the State of São Paulo and match it with employer-employee datas (RAIS), which allows us to follow workers over time and across firms. We document large variation in the degree of pro-continuation bias of Brazilian courts in charge of bankruptcy cases. For identification, we exploit the random assignment of cases across courts within each judicial district. We document that, not surprisingly, employees of firms assigned to pro-continuation courts are more likely to stay with their employer after bankruptcy. However, they earn, on average, 4.5% lower wages three to five years after bankruptcy. In other words, pro-continuation judicial bias leads to higher probability of preserving workers' job at the same firm but at the expense of preventing a job switch that would have led workers to receive a higher wage. We discuss potential mechanisms that can rationalize this result. We provide evidence consistent with workers being imperfectly informed about their outside options in the local labor market (Jäger et al., 2022) and thus earning wages that are below their competitive benchmark.

In a third paper in this line of research, “**Going bankrupt in China**” (Li and Ponticelli [3], *Review of Finance*, 2022), we focus on the issue of political influence on judges in charge of bankruptcy cases. This issue is particularly prominent in China, where local courts traditionally operate under the influence of local party officials, which have strong incentives to keep in operation low-productivity and financially distressed firms to contain unemployment, avoid social unrest and promote their political careers. Government’s protection of insolvent but politically connected firms has been documented in several countries (Faccio et al., 2006). We contribute to the literature by documenting the role played by the judicial system in shaping the treatment of politically connected firms when they enter bankruptcy.

Since little is known about how bankruptcy works in China, we start by constructing a new case-level dataset of bankruptcy cases and provide a set of stylized facts. Then, we study how the introduction of specialized courts affects insolvency resolution and the local economy. In particular, we exploit the staggered introduction of 106 specialized tribunals introduced in China since 2007, and compare bankruptcy cases handled by specialized versus traditional civil courts within the same city and filed in the same year.

We present two main insights. First, as expected, specialized courts substantially decrease case duration relative to traditional civil courts (36% lower time). Second, court specialization increases court efficiency via two channels: (i) selection of better trained judges and (ii) higher judicial independence from local politicians. We test the first channel using new data on the school attended by each judge. We test the second channel by testing for differences in how judges deal with cases of state-owned vs private firms, and by exploiting differences in the incentive to delay

liquidation at different stages of the political cycle of local officials. We also provide suggestive evidence of real effects: cities introducing specialized courts experience a relative reallocation of employment from zombie-firms-intensive sectors to the rest of the local economy, as well as faster firm entry and a larger increase in average capital productivity.

In a related survey article , “**Default and Bankruptcy Resolution in China**” (Hotchkiss, John, Li, Ponticelli, and Wang [10], *Annual Review of Financial Economics*, 2023), we summarize the key findings of the recent but growing literature on insolvency resolution in China. I find this a particularly important topic in light of the recent increase in corporate defaults following the decade-long credit boom that characterized the Chinese economy.

2.2 Preferential access to finance

Preferential access to finance granted to government-connected firms or individuals is another important source of financial frictions in developing countries. This issue has become more prominent after the global financial crisis, when governments in emerging markets have increasingly become active in promoting credit expansions either directly or via government-controlled banks.

In “**Credit Allocation under Economic Stimulus: Evidence from China**” (Cong, Gao, Ponticelli, and Yang [6], *Review of Financial Studies*, 2019), my first paper in this line of research, we use new administrative loan-level data to study the allocation of bank credit across firms in China, and how it has changed following the introduction of China’s economic stimulus plan of 2009–2010. China’s economic stimulus plan aimed to mitigate the effects of the global financial crisis. The plan had two main components. First, an increase in government spending of 4 trillion RMB—or 12.6% of China GDP in 2008— over two years, mostly on infrastructure projects and social welfare policies. Second, a set of credit expansion policies – including lower bank reserve requirements and lower benchmark lending rates – aimed at increasing lending to the real economy by Chinese banks.

To study the effects of this plan on capital allocation in China we match confidential loan-level data from the nineteen largest Chinese banks with firm-level data on manufacturing firms. We construct a firm-level exposure to the credit supply shock generated by the stimulus plan based on pre-existing lending relationships between firms and Chinese banks. Firm exposure is assumed to be higher for firms initially connected to banks that responded the most to the government stimulus.

We document that the stimulus-driven credit expansion disproportionately favored state-owned firms and firms with a lower average product of capital, reversing the process of capital reallocation toward private firms that characterized China’s high growth before 2008. Indeed, our data shows

that in the years up to 2008, China experienced a gradual reallocation of capital from low- to high productivity and mostly private firms, an important driver of its growth performance in that period. Starting in 2008, this trend reversed, with more capital being borrowed by state-owned and low productivity firms. We investigate two potential mechanisms behind this reversal. First, the role of state-owned banks in the stimulus plan and their preferential lending relationships with state-owned firms. Second, the role of implicit government guarantees for state-connected firms, which make lenders favor them more when the probability of financial distress increases.

In a second and related paper, “**Consumption Smoothing or Consumption Binging? The effects of government-led consumer credit expansion in Brazil**” (Garber, Mian, Ponticelli, and Sufi [13], *R&R at the Journal of Financial Economics*, 2023) we expand the study of government interventions in credit markets of developing economies to the household side. Similar to the context of China described above, in the aftermath of the global financial crisis, the Brazilian government encouraged household credit growth with the goal of boosting short-term aggregate demand. In particular, the government initiated a major consumer credit expansion effort in 2011 through the injection of new capital into the two largest government banks. In response, government banks started a large marketing campaign to promote the take up of payroll loans. These are installment loans that allow banks to deduct payments directly from borrowers’ paychecks. As such, individuals with government jobs tend to be the primary target of such loan offers as they have the most dependable payroll stream. Public sector workers were therefore naturally more “exposed” to the government’s credit expansion program, a feature of the institutional setting that we exploit as identification device.

Our goal is to study who borrows more when more credit is made available. One possibility is that credit is taken up by individuals that anticipate higher income growth going forward and want to smooth consumption. Another is that it is taken up by individuals that suffer from present bias or financial unsophistication, leading them to borrow “too much” in response to a borrowing opportunity (consumption binging). This question is important from a policy and welfare perspective, but also hard to answer empirically because it requires to observe borrowing, income and spending at individual level, and then sort individuals along potential consumption smoothing vs binging tendencies. We address this question using new administrative data that allow us to observe borrowing, income and spending at the individual-level. In addition, we develop a new method for estimating workers’ expected income growth and a new measure of financial sophistication based on the description of individuals’ occupations. We show that “consumption smoothing” cannot explain the rise in consumer borrowing. Instead, the evidence supports “consumption binging”: less financially sophisticated workers borrowed more at high real interest rates, and experienced

both higher consumption volatility and lower average consumption in the years following the boom.

A third paper in this line of research is “**Revealing corruption: Firm and worker level evidence from Brazil**” (Colonnelli, Lagaras, Ponticelli, Prem, and Tsoutsoura [2], *Journal of Financial Economics*, 2022). This paper focuses on another source of frictions related to the role of government: preferential assignment of procurement contracts. Corrupt practices in the assignment of government contracts are considered a major barrier to growth due to the costs of doing business that they impose on firms and the distortions in the allocation of resources across and inside firms they may generate (Olken and Pande, 2012).

We rely on micro-data from Brazil to study the real effects of a large anti-corruption program on exposed firms – i.e., on firms revealed by the program to be involved in illegal interactions with the government. Our empirical design relies on a government initiative which randomly audits municipal budgets with the aim of uncovering any misuse of federal funds (Ferraz and Finan, 2008). We study how the plausibly exogenous disclosure of corrupt practices affects the growth of firms involved in illegal interactions with the government. Despite experiencing a decrease in procurement contracts, we find that firms exposed by the anti-corruption program grow larger after the audits. We show that, by restricting a firm’s access to government contracts, the revelation of corruption forces exposed firms to change their investment and business practices to be able to compete for private demand.

2.3 Information frictions

My most recent work in this area studies frictions in information diffusion, with a focus on the role of language barriers. My interest in this issue stems from the high levels of language fragmentation observed in many developing countries – including India and Sub Saharan Africa –, and especially in the poorest communities in these countries, where access to information is limited but potentially more transformative.

In “**Language Barriers, Technology Adoption and Productivity: Evidence from Agriculture in India**” (Gupta, Ponticelli, and Tesei [14], *R&R at the Review of Economics and Statistics*, 2022), we study the effect of language barriers on the ability of farmers to access information about modern agricultural technologies in rural areas of India. For this study, we obtained access to call-level data from the main government-sponsored call centers for agricultural advice, the Kisan Call Centers (KCC). A key feature of KCC is that the service is only offered in the official language of each Indian state. This generates differences in potential access to the service across territorially contiguous areas that sit across state borders, whenever the official language of

a State does not match the official language spoken by the underlying population.

For identification, we exploit these differences in the language spoken by farmers and call center advisors, and focus on contiguous areas across State borders. These areas are comparable across a large set of socio-economic and ethnic characteristics, and follow similar trends in technology adoption and productivity prior to the introduction of KCC. We document that language barriers limit the adoption of modern agricultural technologies, including HYV seeds, fertilizers and artificial irrigation. We find more limited impact of language barriers on agricultural productivity in the first years after the introduction of KCC, although significant differences arise in the longer run.

A second paper in this area of research is “**Information Frictions and Take-up of Government Credit Programs**” (Gupta, Ponticelli, and Tesei [12], 2023). This paper focuses on the impact of a large infrastructure program – the construction of 7,000 mobile phone towers in previously unconnected areas of India – to study how access to information affects loan take-up in rural credit markets. This study is motivated by the fact that, over the past decades, several governments have intervened in rural credit markets, mostly via straightforward subsidization of agricultural credit. While these initiatives have indeed broadened the amount of credit available to farmers, we document that farmers often lack information on how these programs work, their eligibility criteria and loan terms offered. Exploiting plausibly exogenous variation in the construction of new mobile phone towers, we document that areas receiving coverage experience higher take-up of agricultural credit. The effects are concentrated in short-term credit to small farms, which have been the target of a major government subsidized credit program, the Kisan credit cards.

3 Structural Transformation

My second area of research studies the process of reallocation of resources across firms, sectors and regions that economies experience in response to major productivity shocks. In a first strand of this research, I focus technological innovations in the agricultural sector.

Based on the experience of the first industrialized countries, the classic development literature has highlighted how increases in agricultural productivity can foster industrialization and economic development.¹ In particular, technological innovations in agriculture can favor the development of industry and services by freeing labor for other activities (labor channel), increasing demand for manufactured goods (demand channel), and generating savings to finance industrial projects (finance channel). However, the experience of several low income countries appears inconsistent with the idea that high agricultural productivity leads to economic development. Explanations proposed

¹See: Baumol (1967), Murphy et al. (1989), Kongsamut et al. (2001), Gollin et al. (2002), Ngai and Pissarides (2007).

by the theoretical literature include openness to trade (in an open economy, industrial goods can be imported and savings can be exported) and market failures that characterize developing economies and can limit the reallocation of factors of production across sectors. Despite the richness of the theoretical literature and the importance of these channels for the development process, there is scarce empirical evidence testing the mechanisms proposed by these models.

In “**Agricultural Productivity and Structural Transformation. Evidence from Brazil**” (Bustos, Caprettini, and Ponticelli [8], *American Economic Review*, 2016) we provide direct empirical evidence on the effects of technological change in agriculture on labor reallocation across sectors. As a natural experiment, we exploit the recent widespread adoption of new agricultural technologies in Brazil. We focus on two technological shocks. First, the introduction of genetically engineered soybean seeds (GE soy). This new technology – patented in the US and legalized in Brazil in 2003 – requires less labor per unit of land to yield the same output (labor-augmenting technical change). Second, the introduction of a second harvesting season for maize. This technique permits to grow two crops a year in the same plot of land, effectively increasing the land endowment (land-augmenting technical change). Comparing the impact of these two technologies allows us to study how different types of technical change in agriculture can affect structural transformation in open economies.

To guide the empirical work, we build a simple model describing a two-sector small open economy where technical change in agriculture can be labor-augmenting (like GE soy) or land-augmenting (like second season maize). The model predicts that when the increase in agricultural productivity is either Hicks-neutral or land-augmenting, it induces a reduction in the size of the industrial sector as labor reallocates toward agriculture, as in classical open economy models (Matsuyama, 1992). However, if land and labor are strong complements in agricultural production, labor-augmenting technical change (like GE soy) reduces labor demand in agriculture and causes workers to reallocate toward manufacturing. In sum, the model predicts that the effect of agricultural productivity on structural transformation in open economies depends on the factor-bias of technical change.

We test the predictions of the model in the data. To establish the direction of causality, we exploit the fact that these new technologies had different potential impacts on yields depending on geographical and weather characteristics of each region of Brazil. Using FAO GAEZ data, we construct a crop-specific measure of potential increase in yields attainable by each municipality of Brazil if that municipality were to switch from traditional agricultural techniques to advanced technologies such as GE soy or second-season maize.

We find that municipalities where the technology adoption is predicted to generate a larger

increase in potential soy yields were characterized by a faster actual adoption of GE soy. The adoption of the new technology led to an increase in productivity and a reduction of labor intensity in agriculture. Workers released by agriculture were – for the most part – absorbed by the local industrial sector which experienced a reduction in average wages consistent with a positive local labor supply shock. On the other hand, the adoption of second seasons maize slowed down industrialization by attracting workers into agriculture. The different effects documented for GE soy and second-season maize indicate that the type of technical change adopted in agriculture is a key determinant of the relationship between agricultural productivity and industrialization in open economies.

In “**Industrialization without innovation**” (Bustos, Castro-Vincenzi, Monras, and Ponticelli [17], *working paper*, 2023) we push this analysis one step forward. Our previous work shows that the introduction of labor-saving technologies in agriculture can foster structural transformation by freeing workers that find occupation in other sectors. The traditional view is that that this reallocation of agricultural workers into manufacturing can lead to higher economic growth. This is because labor productivity is lower in agriculture than in the rest of the economy (McMillan and Rodrik, 2011). In addition, the manufacturing sector is characterized by economies of scale and knowledge spillovers (Krugman, 1987; Lucas, 1988; Matsuyama, 1992). However, manufacturing productivity growth depends not only on the size of the industrial sector but also on its composition (Grossman and Helpman, 1991). Thus, if workers leaving the agricultural sector are mostly unskilled, structural transformation can reinforce comparative advantage in non-innovating industries, reducing long run growth.

We provide direct evidence on this mechanism in the context of Brazil. We document that regions more exposed to the benefits of GE soy due to their soil and weather characteristics industrialized faster, but experienced lower manufacturing productivity growth over the decade following GE soy legalization. We investigate various mechanisms that could explain why an inflow of unskilled labor toward manufacturing may slow down its productivity. We find that changes in worker composition and lower incentives to innovate within manufacturing play prominent roles.

Overall, our results show that when labor reallocation from agriculture to manufacturing is driven by “push” forces that affect disproportionately the least skilled workers, it can generate an expansion of industries with the lowest contribution to aggregate productivity growth. In this sense, our results are a cautionary tale on the effects of structural change on productivity growth, which is informative for low- to middle-income countries where a large share of the labor force is employed in agriculture, and who import new agricultural technologies from abroad.

In “**Capital accumulation and structural transformation**” (Bustos, Garber, and Ponticelli [4], *Quarterly Journal of Economics*, 2020) we study the effects of a technological shock in agriculture on industrialization via a capital accumulation mechanism. Agricultural productivity growth can increase income and savings of land owners in rural areas, and therefore the supply of capital available to finance projects in other sectors.

Tracing the causal effects of agricultural productivity growth on the allocation of capital across sectors and regions has proven challenging for the literature due to the limited availability of data on capital flows within countries. We overcome this difficulty by using detailed information on deposits and loans for each bank branch in Brazil. We match this data with confidential information on bank-firm credit relationships and employment covering the universe of formal firms. Therefore, our dataset permits to observe capital flows across sectoral and spatial dimensions, and to study their real effects on firm growth.

Using the legalization of GE soy in Brazil as a natural experiment, we document that GE soy adoption generated an increase in bank deposits in rural areas. While there is limited migration of labor in response to agricultural productivity shocks, capital is more mobile. Indeed, we find that banks redirect agricultural savings toward urban regions. To disentangle demand and supply effects, we focus on firms in urban regions that were borrowing from multiple banks before the soy boom. We find that firms with preexisting relationships with banks receiving deposits from the soy boom areas borrow more from those banks, and not from other banks with whom they also had relationships. Most of the new capital was allocated to non-agricultural firms: out of each 1 BRL of new loans from the soy-driven deposit increase, 1.3 cents were allocated to firms in agriculture, 50 cents to firms in manufacturing, 39.7 cents to firms in services, and 9 cents to other sectors.

While there is a rich empirical literature analyzing the determinants of the reallocation of labor both across sectors (Foster and Rosenzweig, 2007) and regions (Bryan and Morten, 2019), our knowledge of the process of capital reallocation is extremely limited. Our work has contributed to the literature by bringing empirical evidence on this process.

4 Adaptation to Climate Change

My most recent area of research studies adaptation to climate change in developing countries, with a focus on the role played by financial institutions in this process. Despite financial institutions can shape how economies adapt to climate change via their lending decisions and their ability to reallocate capital across regions and sectors, there is scarce direct empirical evidence in the literature on their role.

In “**The effects of climate change on labor and capital reallocation**” (Albert, Bustos, and Ponticelli [16], *working paper*, 2023) we study the impact of climate change on the allocation of factors of production both across sectors and across regions using the experience of Brazil. Brazil is particularly suited for this analysis because its climate has already started experiencing the effects of global warming highlighted by climate science. Average temperatures have increased 1°C since 1980, which is above the normal range of variation in the area. In addition, climate models predict a reduction in precipitation in most Brazilian regions, which, as we document in the paper, is already visible in the increase in the frequency of droughts reported by municipalities to the federal government during the last two decades.

To identify the impact of climate change we exploit deviations of meteorological dryness observed in a given region during a given decade relative to the past century. As a measure of meteorological dryness we use the Standardized Precipitation and Evapotranspiration Index, or SPEI (Vicente-Serrano et al., 2010). We document large variation in this measure across Brazilian municipalities, and show that deviations in dryness are “as-good-as-randomly assigned” in the sense that they are uncorrelated with initial municipality characteristics such as income per-capita or urbanization. This permits to construct a differences-in-differences empirical strategy to identify the effects of climate change on factor allocation.

The empirical analysis aims at studying both the *direct effects* of excess dryness on the local labor and capital markets of affected municipalities, and its *indirect effects* on municipalities whose factor markets are integrated with areas suffering excess dryness. We construct a measure of capital market integration across municipalities using the structure of bank branch networks and track changes in banks’ capital allocation across municipalities and sectors using balance sheet data from all bank branches in Brazil (ESTBAN). We construct a measure of labor market integration across municipalities using past migrant networks and track contemporaneous migration flows using Population Census data. Finally, we construct a firm-level measure of labor market integration with each municipality using the employment histories of migrant workers and track contemporaneous worker flows across regions, sectors and firms using social security data from the Annual Social Information System (RAIS).

We document three sets of results. First, regions subject to abnormally dry meteorological conditions experience a sharp and non-linear reduction in agricultural output. These effects are particularly strong for regions experiencing persistent increases in dryness in the last two decades relative to the previous century. This sharp reduction suggests a limited scope for adaptation responses within the agricultural sector such as the adoption of new technologies or changes in crop composition.

Second, we study the effects of excess dryness on capital allocation. In the short run, regions with abnormally dry conditions insure themselves against negative weather shocks by importing capital via the banking sector, while connected regions provide insurance through funding the increase in lending to agriculture in affected regions and are therefore net exporters of capital. However, in the long run, regions affected by a full decade of abnormal dryness (relative to its 100-year average) experience capital outflows driven by a reduction in loans, consistent with a permanent decrease in investment opportunities.

Third, we study the effects of a full decade of excess dryness on labor allocation. Directly affected areas experience a sharp reduction in employment, concentrated in agriculture and services. While local manufacturing absorbs some of the displaced workers, these regions experience large out-migration flows. Regions receiving climate migrants expand employment in agriculture and services, but not in manufacturing. Using social security data, we provide evidence that labor market frictions direct migrants to firms connected to migrants' social networks, which are mostly small and outside of manufacturing. This force generates de-industrialization and increases the weight of small firms in the firm size distribution of destination regions.

In “**Bank Adaptation to Climate Risk: Evidence from Mexico**” (Jaume and Ponticelli [19], *work in progress*, 2023), we study how financial institutions account for the exposure of their clients to climate-related risks when taking lending decisions. To investigate this question, we use detailed loan-level data covering all loans to the agricultural sector originated by Mexican banks between 2010 and 2020. This setting has two important advantages. First, similar to other developing countries, the Mexican economy is characterized by a large share of employment and value added in the agricultural sector, making it particularly sensitive to permanent changes in climate. Second, the National Institute for Ecology and Climate Change (INECC) provided us access to detailed municipality-level predictions on temperature and precipitation trends for the next decades, which we use to construct a measure of exposure to climate-related risks for agricultural firms.

The empirical analysis has two parts. First, we document bank responses to realized weather shocks. Droughts lead to a contemporaneous increase in defaults and, in the year following a drought, banks increase interest rates on new loan contracts to firms located in the municipality where the drought occurred. Second, we compare bank responses to similar realized shocks in areas that are expected to have different exposure to climate change in the 2021-2040 period based on specific predictions from INECC. Preliminary results show no significant differences in the repricing of agricultural loans following droughts across these regions, despite the trends predicted by INECC already materialized in the 2010-2020 decade and, empirically, exposure to future droughts

is a good predictor of both drought persistence and future default. These findings suggest that financial institutions still treat all drought episodes similarly, without taking into account whether regions are becoming more prone to such episodes relative to the past.

Finally, in “**Temperature and Local Industry Concentration**” (Ponticelli, Xu, and Zeume [15], *working paper*, 2023) we use plant-level data from the US Census of Manufacturers to study the short and long run effects of temperature on manufacturing activity. We document that temperature shocks significantly increase energy costs and lower the productivity of small manufacturing plants, while large plants are mostly unaffected. In US counties that experienced higher increases in average temperatures between the 1980s and the 2010s, these heterogeneous effects have led to higher concentration of manufacturing activity within large plants, and a reallocation of labor from small to large manufacturing establishments. We offer a preliminary discussion of potential mechanisms explaining why large manufacturing firms might be better equipped for long-run adaptation to climate change, including their ability to hedge across locations, easier access to finance, and higher managerial skills.

Additional Research: Determinants of Social Unrest

In parallel to my core research agenda on finance and development, I have also been interested in studying the determinants of social protests. Throughout history, social protests have brought issues at the forefront of public debate, influenced policy-makers’ agendas, and, in some instances, forced regime changes. Relative to the existing literature, my agenda has focused on two specific determinants of social unrest: (i) government fiscal policy decisions and (ii) the existence of a historical tradition of anti-government actions within a given community.

In “**Austerity and Anarchy: Budget Cuts and Social Unrest in Europe**” (Ponticelli and Voth [5], *Journal of Comparative Economics*, 2020) we study the role of fiscal policy as a determinant of unrest and violent protests in a historical perspective. The extent to which societies fracture and become unstable in response to drastic retrenchment in the government budget is a major concern for policymakers tackling large budget deficits. To address this question, we construct a new dataset covering fiscal variables for 25 European countries during the period 1919 to 2008. To isolate the effect of policy decisions on social unrest, we propose a new identification strategy that builds on the conceptual framework of Buera et al. (2011), which study the diffusion of market-oriented policy among politicians. In their framework, policymakers’ beliefs about market-oriented policies are influenced by the experience of similar countries that adopted such policies in the past. We apply their strategy to policymakers’ beliefs about austerity measures. We find that policy decisions in a given country are strongly predicted by past fiscal adjustment decisions in

neighboring countries. Using variation in fiscal variables that is plausibly driven by policymakers' discretionary decisions rather than by current economic conditions, we show that expenditure cuts are particularly potent in fueling protests. On the other hand, tax rises have only small and insignificant effects.

In “**Eclipses and the Memory of Revolutions: Evidence from China**” (Miao, Ponticelli, and Shao [18], *working paper*, 2023) we study the historical roots of anti-government protests using the experience of China. We focus on the wave of protests that erupted across China in the first decade of the 20th century and that culminated with the 1911 Revolution and the consequent end of the Chinese Empire. The last ruling dynasty, the Qing, had been in power since 1644 and, during almost three centuries, had faced numerous episodes of local unrest, often in the form of uprisings by farmers against local government officials. Scholars have long argued that a legacy of peasant rebellions constituted fertile ground for the 1911 Revolution. However, establishing a causal relationship is challenging.

To generate plausibly exogenous variation in the incidence of past protests, we exploit differences in the visibility and magnitude of solar eclipses across Chinese counties. In the Confucian tradition, solar eclipses were considered a negative divine signal on the legitimacy of rulers. We document that eclipses are a strong predictor of peasant uprisings. Counties in the totality zone of a solar eclipse are between 15 and 18 percentage points more likely to experience a rebellion in eclipse year relative to other counties in the same province.

Using plausibly exogenous variation in exposure to past eclipses, we show that Chinese counties with a higher incidence of peasant uprisings against local government officials during the Qing dynasty period (1644-1912) had a higher participation in the protests that led to the 1911 Revolution. We provide evidence indicating that the cultural transmission of the past protest experience via the celebration of anti-government leaders is a potential mechanism behind the documented persistence. Our findings suggests that even the memory of events not directly experienced by an individual but that are transmitted across generations within a given community can act as a reference point for future behavior by members of that community.

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