The Political Development Cycle:

the Right and the Left in People's Republic of China from 1953*

Anton Cheremukhin, Mikhail Golosov, Sergei Guriev, Aleh Tsyvinski

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Abstract

We quantify the effects of the political development cycle – the fluctuations between the left (Maoist) and the right (pragmatist) development policies – on growth and structural transformation of China in 1953-1978. The left policies prioritized structural transformation towards non-agricultural production and consumption at the cost of agricultural development. The right policies prioritized agricultural consumption through slower structural transformation. The substantial differences in policies and their volatility led to large effects of the political development cycle in a distorted economy undergoing a structural change compared to the political business cycle in developed economies.

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1 Introduction

The political business cycle, the concept introduced by Nordhaus (1975) and expanded, among many others, by Rogoff (1990), Alesina et al. (1997) and Drazen (2000), is one of the classical topics in economics and in political science. Shifts in policies when parties or politicians are elected or replaced constitute an important source of fluctuations in an economy. In this paper, we argue for the importance of the political development cycle in which the fluctuations of the political power of groups of policymakers who have differing views on economic development may significantly affect growth and structural transformation of an economy.

We study the Chinese economy from 1953, three years after the founding of the People's Republic of China to 1978, the start of the reform period.[1] The scholars of China (for example, Skinner and Winckler (1969), Cheng (1982, Chapter 2; p. 38, 51) and Eckstein (1977, p. 62-63)) argued that one of the defining features of the policies during that period was a pronounced political cycle within which there were substantial changes in development policies. These fluctuations were driven by shifts between the left-wing (Maoist) and right-wing (pragmatist) economic policies. We provide direct empirical evidence for these policies and quantify the effects of the political development cycle. First, we document that the right-wing and left-wing development policies differed substantially. Second, we show that these large policy differences led to amplified effects in an economy that already featured large distortions and was undergoing structural transformation. Third, the volatility of these policy shifts further magnified their effects. Overall, the political development cycle in China, with its distinct right-wing and left-wing policies, had substantially larger effects than those typically found for the more muted political business cycle in developed economies. For example, Drazen (2000) concludes that there are clear partisan and electoral cycle effects on economic activity in the U.S., which increase volatility of growth and inflation over electoral cycles. However,

[1] Our analysis takes as an initial point the year of 1953 — after the Communist Party consolidated power and launched a comprehensive modernization of economy and society. This is also the year when the systematic collection of detailed economic statistics started.

these effects lead to welfare losses smaller in magnitude that overall effects of business cycles, which in turn are estimated on the order of 0.2 percent of GDP. By contrast, the welfare costs of the political development cycle that we estimate are on the order of 20 percent of GDP.

We analyze a two-sector (agricultural and non-agricultural) neoclassical model with distortions or misallocations. Following Restuccia and Rogerson (2017) and Restuccia (2019), we proceed with what they characterize as the direct approach to causes and consequences of misallocation. The essence of this approach is to measure the specific policies or institutions that may be sources of misallocations and TFP differences and assess their consequences within a quantitative model. We thus build on the historical, political science, and economic history literature to directly identify important development policies, measure the distortions they create in the data, and then quantify their effects within a macroeconomic model. One important challenge for the literature on the direct approach to misallocation that Restuccia and Rogerson (2017) and Restuccia (2019) identify is that the literature has not been generally able to show that a relatively small set of factors can account for a quantitively sizable part of distortions and TFP behavior. One important contribution of our paper is to show that one key mechanism – the political development cycle – and several key associated policies that are identified by the scholars of China and that we directly empirically measure make important quantitative contributions to growth and structural transformation.

We construct a comprehensive dataset that allows the application of the neoclassical model to study this period of Chinese development. We provide consistent data series for sectoral output, capital and labor, wages, deflators, and relative prices as well as defense spending and international trade variables.

We then quantify a set of policies that the scholars of China identified as central to economic performance in that period. For each policy we outline a prototype model which allows us to link a theoretical distortion in the model to a specific measurable quantity related to that policy. We provide quantitative micro evidence for each of the

policies and use this direct evidence to construct a calibrated path for each distortion in the quantitative model. Thus, we construct a calibrated economy where only the distortions and the TFP effects linked to estimated policies play a role, and other fluctuations in distortions and TFPs are absent. We quantify the effects of the political development cycle policies using this calibrated economy.

Based on the historical evidence, we view the policy debate between right-wing and left-wing policymakers through the lens of four questions: 1) How much resources to divert from consumption to investment? 2) In which proportions to sacrifice agricultural and non-agricultural consumption? 3) Which type of capital to build up? 4) How to organize production and incentivize workers and peasants? Each question was answered by specific policies, enacted and sometimes curtailed later, which we calibrated based on quantitative direct evidence.

A useful way to summarize the effects of a calibrated policy is by considering the distortions it introduces and the effects it has on the sectoral TFPs in an otherwise standard neoclassical two-sector model. First, the policy of diverting resources resulted in overall scarcity of consumption goods and produced the investment distortion. Both wings of the policy debate agreed on the necessity of industrializing as fast as possible. Second, the policies of rationing and procurement of agricultural goods pursued by the left wing disproportionately sacrificed agricultural consumption that resulted in distorted allocations of labor across sectors. Third, the policy of prioritizing construction and heavy industry pursued by the right wing resulted in a distorted allocation of capital across sectors. Fourth, the left wing pushed for collective production and centralized control, while the right wing argued for some decentralization and a focus on material incentives. Finally, we model and calibrate a number of salient policies that affected the sectoral TFPs such as incentives, communes, self-sufficiency, centralization, and the Third Front. Overall, the differences in the priorities coupled with the shifts in power resulted in the political development cycle driven by the left-wing and the right-wing policy packages, which differ significantly from each other, change frequently, and lead

to substantial volatility in the economy.

We then use the model with the directly estimated policies to evaluate the effects the policy development cycle by running counterfactual experiments. We construct counterfactual paths of the economy if only the right-wing or only the left-wing policy package was implemented. The difference is that the left-wing policy path prioritizes structural transformation towards non-agricultural production and consumption at the cost of agricultural development while the right-wing policy path prioritizes agricultural consumption through slower structural transformation. Both achieve similar increases in investment, GDP and welfare starting from 1970. The left-wing package achieves larger structural transformation at the short-term cost of GDP and welfare in the 1958-65 period. Our main conclusion is that each of these counterfactual paths significantly outperforms the actual path of the economy. The political development cycle instead resulted in large and frequent policy changes that were further exacerbated by the structural transformation of an already distorted economy. Thus, the political development cycle led to the failure to achieve the economic performance that either the left- or the right-wing policies would attain on their own.

While our primary focus is on the pre-1978 period, we also provide a concise analysis of the post-1978 "reform" period.[2] We infer that the main reforms promoted by Deng and subsequent leaders were to bolster TFP growth combined with policies that led to gradual reduction in production and consumption components of the labor distortion. We conduct a counterfactual exercise highlighting how the economy could have evolved if the post-1978 reforms were implemented in 1958. We find that Deng's policy package substantially outperforms not only the baseline but both the right-wing and the left-wing policy packages in terms of GDP, welfare, and structural transformation. While both stable right-wing policies or stable left-wing policies would have notably improved the well-being of citizens compared with the economy with a policy cycle, a hybrid policy combining some of the best elements of both policy packages would have done much

[2]See the working paper version (Cheremukhin et al. 2015) for a more detailed analysis of the post-1978 period.

better.

Related literature There are broadly three main approaches to the study of causes and consequences of distortions in recent macroeconomic literature. The first is the wedge accounting methodology such as Cole and Ohanian (2004), Chari, Kehoe, McGrattan (2007) and, in the structural transformation context, our previous work on Soviet Russia (Cheremukhin et al. 2017).[3] This wedge accounting methodology typically proceeds with calculating distortions that exactly match or, in other words, fully account for the data. These wedges are then used to guide a researcher to determine which policies are important for matching the data. The Chinese economy, especially during Mao's time, featured many policies and distortions that, while important, are difficult to quantify and evaluate within a stark neoclassical model that we use. We thus do not aim to account for the data fully nor do we account for all of the important policies during that period. Instead, we show that the political development cycle and policies associated with it contribute an important part of the Chinese structural transformation and growth experience. Restuccia and Rogerson (2017) and Restuccia (2019) identify two other main related approaches – the indirect and direct approach. The indirect approach follows influential studies of Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) and aims to identify the extent and the effects of misallocation without identifying the underlying source of the misallocation. We follow the direct approach which analyzes the effects of a specific mechanism, the policy development cycle. Restuccia and Rogerson (2017) argue that, even taken together, the effects from the studies using the direct approach are small compared to the indirect effects. In contrast, we show that the political development cycle leads to quantitatively large effects commensurate with those identified by the indirect approach.

We build on the body of literature by the scholars of China who uncovered a broad variety of historical, institutional, policy, and political effects on the economy in the pre-reform and reform periods. These include Eckstein (1977), Lardy (1983), Naughton

[3]For a concise review of the models of structural change, see Matsuyama (2008).

(1986, 1987, 1988) and Lyons (1987), among many others. Our paper fills an important gap by quantifying a number of salient policies studied in this literature in a modern quantitative macroeconomic model. We incorporate the detailed China-specific features into a standard neoclassical growth model in the form of distortions, which we are able to carefully calibrate based on direct micro evidence. We then quantify how individual economic policies affected the path of China's economy and use this model to evaluate alternative policy paths.

There is a large body of macroeconomic research on China's economy in the post-1978 period with only limited macroeconomic analysis of the pre-reform period. On the macro side, prominent existing models of China's economy during and after the reforms include: the landmark book edited by Brandt and Rawski (2008), a quantitative analysis of China's post-1978 structural transformation and sectoral growth accounting by Brandt, Hsieh, and Zhu (2008), Brandt and Zhu (2010) and Dekle and Vandenbroucke (2010, 2012), growth accounting by Young (2003) and Zhu (2012), a model of growing like China of Song, Storesletten, and Zilibotti (2011), a model of transformation of the state-owned firms by Hsieh and Song (2015), a study of misallocation in India and China by Hsieh and Klenow (2009), a study of growth and inflation measurement by Nakamura, Steinsson, and Liu (2016), and a Mandarin model of growth of Xiong (2018). We are aware of only one strand of papers dedicated to model-based macroeconomic analysis of the 1953-1978 period by Chow (1985, 1993) and Chow and Li (2002) whose work mainly focuses on data issues, but none takes a comprehensive macroeconomic view as we do in this paper.

2 The political development cycle

In this section, we summarize a large literature which describes shifts between the left-wing and the right-wing policies during Mao's reign and provides the context for the right-left policy development cycle.

The literature on the policy cycle in communist China starts with the work of Skinner and Winckler (1969) who describe a model in which the society moves between the liberal phase with reliance on remuneration and the radical phase with reliance on exhortation and coercion. An important study of the economy of China by Chu-yuan Cheng starts with the analysis of ideological background of Mao and views growth and economic development through the "Struggle between two lines" – the Maoists and the pragmatists (such as Zhou Enlai, Liu Shaoqi, Deng Xiaopin, and Sun Yefan) with the divergent views on "incentives and the path to modernization." The book concludes "Of all the factors affecting the Chinese economy, the primacy of ideology probably has had the most profound impact" (Cheng 1982). Perhaps the most influential view of the Chinese policy cycle is due to Alexander Eckstein (1977): "the policy cycle revolves around [the regime's commitment to the Maoist vision of] resource mobilization–production nexus on the one hand, and the dichotomy between model Communist Man and Economic Man on the other. Consequently, the dilemma facing the regime is that precisely the kind of measures imposed to mobilize resources tend to (a) produce strong disincentive effects, and (b) lead to losses in productive efficiency."

The policies of the mobilization phase "may take a variety of forms, depending on what period in Communist China's economic history we are considering". Yet their general features are: (1) designed to raise the level of extraction from the countryside; (2) curtail the scope of private industry and commerce; (3) "general lessening of reliance on material incentives in both agriculture and industry". These policies "tend to have strong disincentive effects ... aggravated by the fact that frequently, if not invariably, these policies are accompanied by the introduction of some new institutional forms ... [which are] in themselves disruptive". The cumulative negative effect on the economy "forces the regime to shift its policy mix" to the right-wing policies broadly characterized as: (1) "easing the pressures on the peasantry, that is, more favorable prices, greater scope of the private plots, greater scope of the rural markets, and less control of labor allocation and mobilization"; (2) encouraging "capitalist tendencies" – increased reliance

on material and financial incentives.

Eckstein (1977, p. 42-43 and 46-48) summarizes that "policy differences ... revolve around two basic issues: the desired or feasible rate and character of economic growth and the role of the market or of centralized versus decentralized patterns of decision making in allocating resources". Another evidence is "the ever present controversy best dramatized by the slogan that pits "Red" versus "Expert" where the group of "counselors of caution", "the planners, economists, and technocrats" were "locked in debate with the more political and radical elements identified with Mao" "at all the crucial policy turns, such as those relating to collectivization, the Great Leap, the Agriculture First Policy, and the Cultural Revolution". Cheng (1982, p. 323-324 and Chapter 9-10 for a detailed analysis) summarizes "Generally speaking, periods of radical experimentation were succeeded by periods of retreat and adjustment ... economic policy changes in China have been closely tied to leadership changes".

Additionally, Nathan (1976, p.723-724) reviewing the literature argues that the research on policy cycle identifies the following general features of the left-wing and right-wing policies. "In agriculture, a rightist line involves a greater appeal to selfish, materialistic motives on the part of peasants in the form of free markets, private plots, piece-work rates, a greater flow of consumer goods to the countryside, decentralization of management to the team level, smaller state procurement from the harvest, and greater state investment in agriculture through fertilizer and mechanization ... Thus a right line in agriculture is connected to a right line in industry (balanced, planned investment and centralized management; greater technical sophistication; slower, more stable growth; reliance on material incentives to both workers and managers)".[4] "A leftist line involves greater appeal to self-sacrificing mobilizational or ideological motives, and hence a reduction in the role of free markets and private plots, the politicization of remuneration systems, recentralization of decision-making to the brigade or commune level, higher

[4]Nickum (1978) argues that substantial part of state infrastructure investment in agriculture (investment in "land-augmenting fixed capital") was carried out by agricultural labor in off-peak seasons; this is consistent with the rightist line's pragmatic approach to resource allocation.

state procurement, and reduced state subvention of fertilizer and mechanization ... Similarly, a left line in agriculture is associated with left lines in other policy areas: a more rapid but inefficient, decentralized growth of a less sophisticated industrial sector with greater worker participation in management and more reliance on ideological incentives; subordination of intellectuals and technicians to political cadres and the masses".[5]

For the analysis of the political development cycle we now classify 1953-78 into periods of right-wing and left-wing policies. We follow Eckstein (1977) to classify the following major periods: the technocratic First Five Year Plan (1953-1957) as mostly the right-wing strategy;[6] the Great Leap Forward (1958-1961) as the left-wing strategy; the retrenchment and recovery period and the Agriculture First policy in the early 1960s (1962-1966)[7] as the right-wing strategy. We classify the period of 1967-1972 as the left-wing policy, when the "Cultural revolution" policies were started and the military was tasked with restoring order in the country and rebuilding economy under Lin Biao. We classify the period of 1973-1975 as the right-wing policy under the premiership of Deng Xiaopin (Cheng (1982)). We classify the period of the struggle for power 1976-1977 as left-wing policy starting with the rule of the ultra-leftist Gang of Four and ending with the restoration of Deng in July 1977 and with affirmation of the modernization program at the Fifth National People's Congress in February 1978.[8]

[5]More broadly, see the debate of Nathan (1976) and Winckler (1976) on the policy cycle.

[6]We omit the period of collectivization of 1955-1956 in this classification as it was rather mild and "limited the disorder and destruction of economic resources" (Teiwes 1987, p.111) as well as affecting primarily agriculture.

[7]See also Riskin (1987, p. 163-169) and Selden (1979, p.105 and Table 16, p.154-155).

[8]Our classification is broadly consistent with the textbook treatment of Naughton (2007) who considers Economic Recovery (1949-52), the Twin Peaks of the First Five-Year Plan (1953-1956), Great Leap Forward (1958-1960), Crisis and "Readjustment" (1961-1963), Launch of the Third Front (1964-66), the Cultural Revolution (1967-69), the Maoist Model: a New Leap (1970-1972), Consolidation and Drift (1972-76), and the Leap Outward and End of Maoism (1978-). See also a book-length study of the cycles in Chinese foreign economic policy (Reardon 2015).

3 Model

We consider a standard two-sector (agricultural (A) and non-agricultural (M)) neoclassical model.[9]

The preferences are given by:

$$\sum_{t=0}^{\infty} \beta^t U\left(C_t^A, C_t^M\right), \tag{1}$$

where

$$U\left(C_t^A, C_t^M\right) = \left[\eta^{\frac{1}{\sigma}} \left(C_t^A - \gamma^A\right)^{\frac{\sigma-1}{\sigma}} + (1-\eta)^{\frac{1}{\sigma}} \left(C_t^M\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

C_t^A and C_t^M are per capita consumption of, respectively, agricultural and non-agricultural goods; $\gamma^A \geq 0$ is the subsistence level of consumption of agricultural goods; η is the long-run share of agricultural expenditure in consumption. The discount factor is $\beta \in (0,1)$, and σ is the elasticity of substitution between the two consumption goods. Each agent is endowed with one unit of labor services that he supplies inelastically.

Output in sector $i \in \{A, M\}$ is given by: $Y_t^i = F_t^i\left(K_t^i, N_t^i\right) = X_t^i \left(K_t^i\right)^{\alpha_{K,i}} \left(N_t^i\right)^{\alpha_{N,i}}$, where X_t^i, K_t^i, and N_t^i are, respectively, total factor productivity, capital stock, and labor in sector i. The capital and labor shares $\alpha_{K,i}$ and $\alpha_{N,i}$ satisfy $\alpha_{K,i} + \alpha_{N,i} \leq 1$. Land is available in fixed supply, and its share in production in sector i is $1 - \alpha_{K,i} - \alpha_{N,i}$. We denote by $F_{K,t}^i$ and $F_{N,t}^i$ the derivatives of F_t^i with respect to K_t^i and N_t^i.

The total population in period t is denoted by N_t, and is exogenous. The feasibility constraint for labor is $N_t^A + N_t^M = \chi_t N_t$, where χ_t is an exogenously given fraction of working age population. New capital I_t can be produced only in the non-agricultural sector. The aggregate capital stock satisfies the law of motion $K_{t+1} = I_t + (1-\delta) K_t$, where δ is the depreciation rate. Denoting by K_t^A and K_t^M the capital stock in agriculture and manufacturing, the feasibility condition for intersectoral capital allocation is $K_t^A +$

[9] This setting is in line with the models of structural change of Caselli and Coleman (2001), Kongsamut, Rebelo and Xie (2001), Stokey (2001), Ngai and Pissarides (2007), Hayashi and Prescott (2008), Acemoglu and Guerreri (2008), Buera and Kaboski (2009, 2012), Herrendorf, Rogerson and Valentinyi (2014), and Cheremukhin et al. (2017).

$K_t^M = K_t$. Net exports of agricultural and manufacturing goods, E_t^M and E_t^A, and government expenditures on manufacturing goods, G_t^M, are exogenous. The feasibility conditions in the two sectors are $N_t C_t^A + E_t^A = Y_t^A$, and $N_t C_t^M + I_t + G_t^M + E_t^M = Y_t^M$.

The efficient allocations in this economy satisfy three first order conditions: the intra-temporal labor allocation condition across sectors:

$$1 = \frac{U_{M,t}}{U_{A,t}} \frac{F_{N,t}^M}{F_{N,t}^A}, \tag{2}$$

the intra-temporal capital allocation condition across sectors:

$$1 = \frac{U_{M,t}}{U_{A,t}} \frac{F_{K,t}^M}{F_{K,t}^A}, \tag{3}$$

and the inter-temporal condition:

$$1 = \left(1 + F_{K,t+1}^M - \delta\right) \beta \frac{U_{M,t+1}}{U_{M,t}}, \tag{4}$$

where $U_{i,t}$ is the marginal utility with respect to consumption of good i in period t.

Consistent with the literature, we set the shares of capital and labor in the non-agricultural sector to $\alpha_{K,M} = 0.3$ and $\alpha_{N,M} = 0.7$, respectively. We set the shares of capital and labor in the agricultural sector to $\alpha_{K,A} = 0.14$ and $\alpha_{N,A} = 0.55$, respectively. We picked our technology specification close to Hayashi and Prescott (2008).[10]

For our baseline preference parameters σ, η, and γ_A we choose the values at the higher ends of the ranges used in the literature; lower values would make our results stronger. In particular, for our baseline preference specification we chose a commonly used Stone-Geary specification which sets $\sigma = 1$. Parameter η measures the long run share of agricultural consumption and we set it to 0.15. Both of these parameters are

[10] Our elasticities for the agricultural sector are also in line with estimates of Tang (1984), who uses the contributions of labor, capital and land at 0.5, 0.1 and 0.25, respectively, with the remaining share of 0.15 assigned to intermediate inputs. See p.89 and Appendix Table 9, p.228 in Tang (1984) for the discussion of the consistency of these input weights with a number of other countries. However, there is a large variation in estimates of factor shares in Chinese agriculture in the literature, summarized by Wen (1993, Table 9, page 27).

consistent with the literature that used the two sector growth model to study growth and structural transformation in a variety of historical episodes.

We set the subsistence level to 54 yuan per capita per year in 1978 prices. We estimate this number using the purchase price of 0.172 yuan per kg of unhulled rice in 1957 (Swamy 1969, Table 5), convert it to 1978 prices using the state list price index (Zhang and Zhao 2000, Table 7) to arrive at the 215 kg of rice per year. This corresponds to the 1587 kcal average daily rural per capita energy intake, the lowest in 1952-1978 period (Ash 2006, Table 6). This subsistence level accounts for 53 percent of agricultural consumption per capita in 1953. We discuss in Section 8 how our main results change in response to alternative calibrations of the subsistence parameter, as well as other parameters.

We choose the initial capital stock to match the observed level of capital in 1952. The discount factor β is set to 0.96 and depreciation rate δ is set to 0.05, consistent with the annual frequency of the data. Finally, for χ_t, the paths of both the population and the labor force are assumed to change exogenously in line with the data.

4 Data

In this section we discuss the construction of the data for a systematic analysis of the structural transformation of the Chinese economy from 1952 to 1978.[11]

4.1 Data sources and construction of the data

Our two main sources of data on China national accounts are the yearly "China Statistical Yearbooks" (CSY) and the "60 Years of New China" (60Y). Both sources are published by the Chinese National Bureau of Statistics (NBS). The second source aggregates data from previous publications for the years 1949-2009 and is also closely related to a book

[11]The detailed data series until 2012 are provided in the working paper Cheremukhin et al. (2015) and Section 1 of the online appendix.

on pre-1996 statistics compiled by Hsueh and Li (1999), "China's national income 1952-1995" (HL).

An important question to ask is about the quality of the the data on China, especially for the pre-1978 period. We acknowledge that there is a large range of uncertainty about the data and concerns about its reliability (see, for example, Sinha (1975), Rawski (2001) and Maddison and Wu (2008)). The data issue is most acute during the period of the Great Leap Forward when the statistical collection and analysis were significantly disrupted (see discussions in e.g. Rawski (1976) and Holz (2014a)). At the same time, the data is not necessarily unreliable. Holz (2003) argues for the satisfactory quality of the data and cites the findings of a number of key Chinese economic data experts: "Dwight Perkins in 1966 concluded that falsification of disaggregated data is highly improbable. Thomas Rawski in 1976 argued that "statistical information published in Chinese sources provides a generally accurate and reliable foundation on which to base further investigations." Chow (2006) writes that "Statistics are by and large reliable and useful for drawing conclusions about the Chinese economy, but some statistics are not reliable" and yet "any serious scholar using the Chinese official data ... would need to exercise caution in his research even if the data are not purposely falsified".

Given the concerns on the quality of the data, we pursue two approaces to alleviate them. First, whenever possible, we provide a range of available estimates and alternative data sources. Second, in Section 8, we provide a comprehensive sensitivity analysis with respect to data choices, as well as to calibration and to judgement calls that we make.

We use nominal value added by sector and the growth rate of real value added by sector to construct indices of real value added in the agricultural (primary) sector and the non-agricultural (secondary and tertiary) sector in 1978 prices. The same sources allow us to estimate the relative prices of agricultural goods to non-agricultural goods by taking the ratio of price deflators in the two sectors. The price deflator in each sector is computed as the ratio of nominal to real value added in that sector. The ratio of price deflators equals 1 in 1978 by construction. We use gross fixed capital formation in current

prices which serves as our measure of nominal investment. We convert investment (as well as other components of GDP) from nominal to real values using the GDP deflator. This measure works well for the later part of the sample, but for the pre-1970 period it implies unrealistically low values for non-agricultural consumption, which is computed as the residual between value added, government, trade and investment. We eliminate the influence of this issue on the calibrated levels of the capital and labor distortions by augmenting our estimates with data on non-agricultural consumption expenditure from CSY, Table 2.19. Data on non-agricultural consumption for the 1952-74 period is converted to 1978 yuan using the non-agricultural value added deflator, and investment is computed as the residual for the same period. We discuss alternative data sources and the reasons behind this choice in Sections 1.8 and 2.3 of the online appendix.

We use Holz (2006), Tables 19 and 20 on pages 159-161, as our main source for the aggregate and sectoral capital stock. We use the level of capital and its ratio to GDP in 1953 to estimate the initial level of capital in 1978 prices. We apply the perpetual inventory method (with a depreciation rate of 5 percent) to our series for real investment in 1978 prices to obtain the series for aggregate capital in 1978 prices. The series that we obtain is largely consistent with Holz's estimates of aggregate capital stock, with two minor differences: Holz computes capital in constant 2000 prices and uses a variable depreciation rate which ranges between 3 and 5 percent.

We also use data from Holz (2006) to divide the aggregate capital stock into capital used in the agricultural and non-agricultural sectors. This sectoral division of capital stock is only available for 1978. For earlier years we use the data on sectoral investment from Chow (1993) to estimate the composition of capital stock by sector. We use net capital stock accumulation by sector from Table 5 on page 820 in Chow (1993), and then apply the perpetual inventory method to estimate sectoral capital stock for 1953-1978. We allocate the total real capital stock in 1978 prices by sector using the relative proportions implied by Chow's data. We have also constructed data on the sectoral capital stocks using provincial data; the results are consistent with our main series.

Another alternative series is farm capital from Tang (1984) which we discuss together with provincial data in Section 1.8 of the online appendix.

For labor input, we use data on population, employment and its composition from the two primary sources (60Y, CSY). We adjust the employment numbers prior to 1990 using the procedure proposed by Holz (2006), Appendix 13, page 236. The correction addresses the reclassification of employed workers that was made by the NBS in 1990.

For data on wages by sector we use average wages for staff and workers in the agricultural and non-agricultural sectors. The pre-1978 data come from CSY for year 1981. One issue with these data is that the wages of staff and workers may not be the same as labor remuneration for workers. Staff and workers are concentrated in non-agriculture, and to the extent that they are in agriculture, they are likely to be in state farms.[12] We address this concern by computing the ratio of labor remuneration in non-agriculture to agriculture from Bai and Qian (2010). We find that the ratio of two series behaves similarly for the overlapping time period.

Our primary source of data on sectoral price indexes is the CSY. We use sectoral value added deflators obtained earlier when computing real value added by sector. We consider an alternative source of data on relative prices, Young (2003), in Section 8.

The data on defense spending comes from HL and CSY which joinly cover the 1952-1995 period and report nominal defense spending in yuan. We obtain an estimate of real defense spending in 1978 prices multiplying the share of defense in GDP by real GDP.

The main source for data on sectoral exports and imports is Fukao, Kiyota, and Yue (2006). Fukao et al. report data on China's exports and imports by commodity at the SITC-R 2-digit level for 1952-1964 and for 1981, obtained from the "China's Long-Term International Trade Statistics" database. Using data from Fukao et al. (2006), we construct estimates of nominal exports and imports of agricultural and non-agricultural commodities. We then subtract imports from exports to obtain estimates of net exports by sector. We use the price deflators computed earlier to estimate real net exports by

[12] See, for example, Holz (2014b) for detailed data.

sector in 1978 prices. For the 1965-1978 period, to our knowledge, there is no available data on trade by sector as the economy was essentially closed to foreign trade. We linearly interpolate the ratios of net export to value added by sector for this intermediate period.

We convert real GDP per capita in 1978 prices to 1990 international dollars using Maddison's estimate of 838 dollars of 1990 per person for the year 1973. We then apply real GDP growth rates (in constant 1978 prices) to construct real GDP per capita in international dollars for other years in the 1952-2012 period. This series may differ slightly from real GDP in international dollars reported by Maddison for other years, as relative prices changed. However, our index captures well the general patterns and the long-term growth rates.

4.2 Summary of the data

In 1950, China was a poor, heavily agricultural country. Its GDP per capita in 1990 international dollars was 448, less than the average income in the previous two millennia, due to the major disruptions during the civil war period.

The Chinese economy in 1953-1978 grew rapidly, as shown in Figure 1, with a 5.6 percent average rate of growth of real GDP (3.6 percent per capita). Agricultural value added grew at 2.1 percent while manufacturing value added grew at 9.0 percent per year. PRC's economy industrialized considerably, as investment's share of GDP grew from 5 percent in 1953 to nearly 30 percent in the late 1970s. However, the economy did not experience structural transformation. In 1953, the primary occupation for 83 percent of the working-age Chinese population was agriculture. This fraction declined very slowly (with the exception of the brief period during the GLF when about 20 percent of the labor force temporarily moved from agriculture to manufacturing) and the ensuing Agriculture First policy that reversed the flow, remaining above 80 percent until 1970 and declining to 75 percent in 1977. The role of agriculture in GDP declined much faster, with 68 percent of value added produced in agriculture in 1953 and only 30 percent in

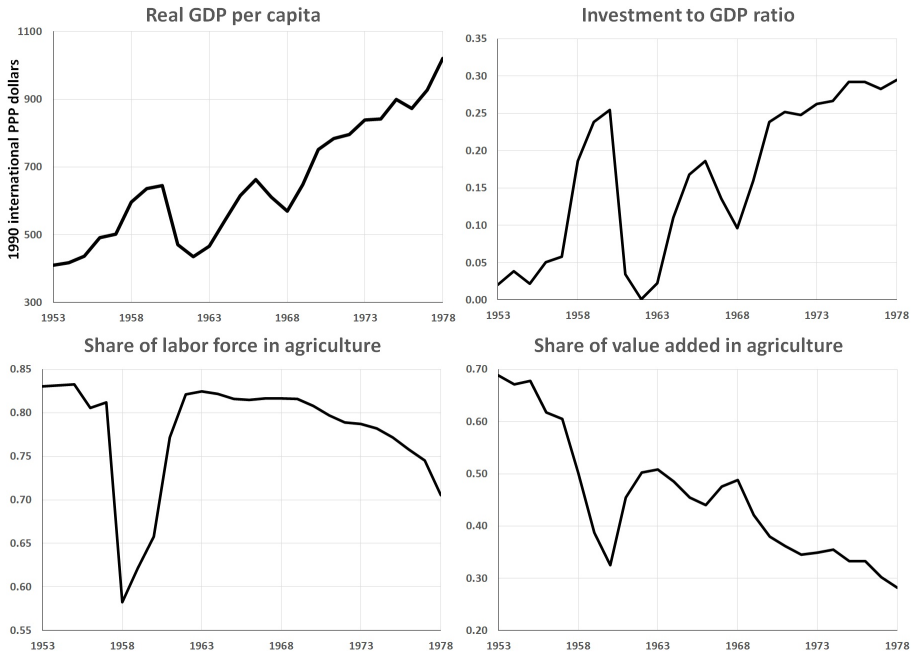

Figure 1: Macroeconomic indicators of People's Republic of China, 1953-78

1977 (with a similarly brief downward shift during the GLF). International trade was insignificant – China's net export of agricultural production was only 3 percent prior to the GLF and declined to zero after 1960.[13] The imports of non-agricultural goods constituted an even smaller fraction of non-agricultural value added in the same period. Defense spending was a large component of manufacturing production accounting for 6 percent of GDP.

5 Modeling and quantifying policies

In this section, we provide detailed modeling and quantification of the most salient right-wing and left-wing policies. Our approach follows what in a comprehensive review Restuccia and Rogerson (2017) call a direct approach to studying the causes and consequences of misallocation. We start with the main features of the policies that are

[13]Chinn (1981) points to growing "calorie arbitrage" in 1961-1976 when China exported rice and imported wheat gaining net positive calories with zero net agricultural exports. However, Chinn's estimates suggest that even by the end of this period, the calorie arbitrage was only in the range of 0.2 percent of China's GDP.

identified by the historical, political science, and economics literature on China. We then provide models that formalize these features, link the policies to a specific measurable quantity in the model and then provide direct evidence for that measure. Our primary criterion for inclusion of a measurable quantity is twofold: (1) there is direct comprehensive historical evidence for a policy and its effects are supported by a variety of sources; (2) wherever possible there are at least two different empirical proxies which are consistent with each other.

A useful way to organize the description of the policies is to focus on the distortions or the wedges that they introduce in the first order conditions (2)-(4) of the baseline model in Section 3. In contrast to the wedge accounting methodology (Chari, Kehoe and McGrattan (2007), Cole and Ohanian (2004), Cheremukhin et. al. (2017)), we do not seek to back out wedges from the data and thus to match or account for the data fully. Instead, we analyze how several salient polices result in the changes in the corresponding distortions.

We introduce three distortions $\tau_{W,t}$, $\tau_{R,t}$, and $\tau_{K,t}$ as the right-hand sides of expressions (2), (3), and (4). We also study components of the distortions. Let $p_{i,t}$ and $w_{i,t}$ denote the prices of goods and wages in a competitive equilibrium. The right-hand side of the intra-temporal optimality condition for labor (2) can be re-written as a product of three terms, to which we refer as *consumption*, *production,* and *labor mobility components*:

$$\frac{U_{M,t}}{U_{A,t}}\frac{F^M_{N,t}}{F^A_{N,t}} = \underbrace{\frac{U_{M,t}/p_{M,t}}{U_{A,t}/p_{A,t}}}_{\text{consumption component}} \times \underbrace{\frac{p_{M,t}F^M_{N,t}/w_{M,t}}{p_{A,t}F^A_{N,t}/w_{A,t}}}_{\text{production component}} \times \underbrace{\frac{w_{M,t}}{w_{A,t}}}_{\text{labor mobility component}} . \tag{5}$$

In the competitive equilibrium decentralizing the efficient allocation, all three components are equal to one. Each of these components is an optimality condition in one of the three markets. In the distorted competitive equilibrium the deviation of each term from one represents the friction in the respective market. The first, consumption component is the friction in the optimality condition of consumers. The second, production

component is the friction in the optimality condition of competitive, price-taking firms. The third, mobility component measures frictions in labor allocation between sectors, conditional on the relative wages. An analogous decomposition can be done for the intersectoral capital distortion (3). As we do not have reliable data on interest rates in each sector, we decompose the intratemporal capital distortion only into two components, *consumption* and *non-consumption components*.

$$\frac{U_{M,t}}{U_{A,t}}\frac{F^M_{K,t}}{F^A_{K,t}} = \underbrace{\frac{U_{M,t}/p_{M,t}}{U_{A,t}/p_{A,t}}}_{\text{consumption component}} \times \underbrace{\frac{p_{M,t}F^M_{K,t}}{p_{A,t}F^A_{K,t}}}_{\text{non-consumption component}} .$$

Note that the consumption component is common for the labor and capital distortions. Now the two-sector neoclassical growth model contains seven different sources of distortions: the consumption component of labor and capital distortions, the production and mobility components of the labor distortion, the non-consumption component of the capital distortion, the investment distortion, agricultural TFP, and non-agricultural TFP, which we all consider to be affected by government policies.

5.1 Rationing and goods shortages: Consumption component of the capital and labor distortions

The Chinese economy featured a number of important distortions that affected consumption choices. Prices on most of the goods were set by the state, many goods were rationed, and shortages were widespread. We now outline a simple model of consumer choice given prices set by the government where consumers are subject to goods rationing. Consider a static economy with agricultural and manufacturing goods con-

sumed by the representative household:

$$\begin{aligned} \max U\left(c_A, c_M\right) + k, & \\ p_A c_A + p_M c_M + k \leq W, & \qquad [\lambda] \\ p_A c_A \leq p_A \bar{c}_A, & \qquad [\lambda_A] \\ p_M c_M \leq p_M \bar{c}_M. & \qquad [\lambda_M] \end{aligned}$$

Here, k is a linear consumption good that can be thought of as either money or capital, p_A and p_M are the observed retail prices (set by the government), $\bar{c}_A$, $\bar{c}_M$ are the set rations of each good, and λ, λ_A, and λ_M are the corresponding Lagrange multipliers. The first-order conditions imply:

$$\begin{aligned} U'_{c_A} &= p_A\left(1 + \lambda_A\right), \\ U'_{c_M} &= p_M\left(1 + \lambda_M\right), \\ \lambda &= 1. \end{aligned}$$

Suppose we observe the price on the free market for agricultural goods p^A_{fm}. This price is the shadow cost of rationing and thus is equal to $p^A_{fm} = p_A\left(1 + \lambda_A\right)$. Then

$$\begin{aligned} U'_{c_A} &= p^A_{fm}, \\ \frac{U'_{c_A}}{p_A} &= \frac{p^A_{fm}}{p_A}. \end{aligned}$$

This model shows that the consumption distortion $\frac{U'_A/p_A}{U'_M/p_M}$ can be measured using the ratios of the prices on the free market to the state-set prices $\frac{p^A_{fm}/p_A}{p^M_{fm}/p_M}$ thus measuring the shadow cost of rationing. For this logic to apply, it is important that the allowed trades on the free market are sufficiently small or that trading imposes some additional costs. If, on the contrary, the consumer can purchase freely additional goods on the free market then there is no additional distortion.

We do not have information on the free markets of the manufacturing goods but we do have the information on the price of the free markets of the agricultural goods (and on the ratio of the free market price to the state list price). Thus we can find the portion of the consumption component change that can be accounted for by the change in the ratio of the free market price to the list price. When the rationing of the agricultural goods becomes tighter, the consumption component of the distortion decreases as the relative distortion of manufacturing goods decreases).

The data on the market price as a percentage of the list price for 1952-1961 is constructed by Sheng (1993b) and from 1962-1978 it is available from China Trade and Price Statistics (1989). For the year where both of the series overlap, 1961, we take the data from Sheng (1993b) for consistency. The ratio $\frac{p^a_{fm}}{p_a}$ is 1.32 in 1952, increases dramatically to 4.13 in 1961,[14] falls to 1.36 in 1964 and rises to 1.69 in 1978.[15] With regard to the quantity of the transactions on the free markets there are two sources of data. First, Zhang and Zhao (2000, Table 5) report purchase of agricultural products by user; we use the proportion sold to Non-Agricultural Domestic Consumers that excludes the goods sold to the State commercial, industrial, and other departments. The second source of data is the volume of transactions in pre-1978 free markets is Naughton (1986, Table E1, p. 233) for 1965 and 1974-1978. Both are consistent with aggregate data on sectoral consumption.

The second method for providing evidence for the change in the degree of shortages is using the data by Niu et al. (1991, Table 7 in Zhang and Zhao 2000). They construct an estimate by which the state purchasing price is below "real value" for agricultural products. Despite the fact that these estimates are based on the Marxist labor theory of value, a broad comparison of the trends is still useful.[16] We convert these estimates to

[14] China Trade and Price Statistics (1989) gives the value of 3.20 for 1961.

[15] The behavior of the consumption component is consistent with the voluminous literature on how the state used the policy of suppressing agricultural consumption to mobilize capital resources for industry (see, for example, Ishikawa (1967) for the paper that started this literature, Chapter 3 "Prices and intersectoral resource transfers" in Lardy (1983), a book length treatment by Sheng (1993a), and references therein).

[16] See an extensive discussion of the Chinese estimates of the degree of underpricing of the agricultural goods ("the value scissors" are contrasted to the "price scissors" which measure the terms of trade between the sectors) in Sheng (1993a, Chapters 2 and 5).

find the "real value" of agricultural goods as percentage of the list price that parallel the discussion above of the free market to the list prices. The "real value" is 1.196 in 1952, increases dramatically to 5.45 in 1961, falls to 1.68 in 1961 and rises to 2.43 in 1978.

Since both of these proxies are only indexes capturing the change in the consumption component of the distortion over time, we need to use the aggregate data to infer the absolute level of this component in some base year T_0. Thus, we can construct two proxy series for the direct calibration of the consumption component as follows:

$$\tau_t^c = \tau_{T_0}^c \left(\frac{p_{fm,T_0}^A}{p_{A,T_0}} \right) \left(\frac{p_{fm,t}^A}{p_{A,t}} \right)^{-1}.$$

We link both proxies to the absolute level of distortion in 1953 and use the first rescaled proxy for the 1953-60 period, and the second series for the 1961-78 (because it matches more closely the 1978 level of the distortion). Both proxies for the consumption component of the distortion show the fall in the distortion during the Great Leap Forward, the recovery during the Agriculture First policy period, and then the gradual subsequent decrease towards 1978.

It is important to note a limitation of the representative agent model, especially in the context of the consumption distortion. While in all our simulations consumption of the representative consumer is above the subsistence constraint, the evidence from, for example, Meng, Qian, and Yared (2015) for the Great Leap Forward points to such constraints either binding or being violated. From the point of view of the representative agent, such heterogeneity may appear as an additional distortion. While modeling such heterogeneity is a difficult task that would require taking a stance on, for example, how to deal with the famine and deaths of the agents, our robustness exercises where we increase the level of the subsistence constraint partially alleviate these concerns.

5.2 Procurement and implicit taxes on production: Production component of the labor distortion

The second set of policies that we consider are driven by procurement and other implicit taxes on production.

Consider a simple model of an agricultural firm that has only labor as a factor of production and has to deliver a portion τ of the output to the state. The firm's objective is then given by $(1-\tau)\, p^A F^A(N^A) - w^A N^A$ and the first order condition is given by $\frac{p^A F_N^A}{w^A} = \frac{1}{1-\tau}$. Hence, τ is a standard tax on output: when it rises, agriculture becomes less attractive compared to manufacturing and the production component of the labor distortion decreases. Similarly to the previous subsection, we do not have micro data for manufacturing sector, but we can use the data for agricultural sector to compute the agricultural part of the production component of the labor distortion, $\frac{p_A F_N^A / w_A}{p_M F_N^M / w_M}$.[17] We use two methods to proxy for this distortion.

Lardy (1983, p. 18-20) argues that procurement of agricultural products by state was a major instrument of the "oscillation between indirect and direct planning (and) have had major effect on the rate of growth and composition of aggregate farm output and the efficiency of resource allocation".[18] Similarly, Li and Yang (2005) show empirically that excessive procurement was second only to diversion of resources from agriculture in explaining the collapse of the agricultural output during the Great Leap Forward. Hence, we use state procurement of agricultural goods to proxy for the degree of such implicit tax. Specifically, we use data from Ash (2006, Table 3) and Li and Yang (2005, Table 1) to measure the distortion as one minus the ratio of gross procurement of grain

[17] Note that we modeled the tax as proportional to output. Evidence from Meng et al (2015) points that at least some of the procurement was conducted in a lump-sum way. While a lump-sum tax would not result in any distortion, the interaction of it with some other production constraints such as a financial constraint creates a potentially similar distortion.

[18] See an extensive discussion in Lardy (1983b) on how procurement is an implicit tax on agriculture, in Eckstein (1977, p. 51) that state agricultural trading companies earned large monopoly profits through imposing an implicit involuntary tax on the peasants, and the discussion of monopoly and monopsony power of the state trading companies in allowing to manipulate the terms of trade between agriculture and manufacturing and to extract resource from agriculture in Lardy (1983, p. 123-125).

to rural grain supply. As the second method, we use the results from Imai (2000, Table 3) who measures price and wage distortions associated with implicit taxation of labor in the non-agricultural sector. Using his method, measuring the ratio of terms of trade under the assumption of zero implicit tax and the actual terms of trade is equivalent to measuring the production component of the labor distortion.[19]

We combine the two methods to calibrate the production component of the labor distortion in the model. As in the previous subsection, both series are indexes capturing the change in the production component over time, so we use the aggregate data in a base year to calibrate the absolute level of this component. We use base year 1956 for the estimate from Ash (2006), and 1978 for the estimate from Imai (2000), and switch from the first estimate to the second in 1964. The resulting calibrated series show the dramatic drop in the production component during the Great Leap Forward and the increase in this component in the subsequent period.

5.3 Mobility restrictions: Mobility component of the labor distortion

The third set of policies we are interested in are the policies that affected the allocation of labor across sectors by affecting the mobility of labor across sectors. The mobility component of the labor distortion is constructed as simply the ratio of wages in the non-agricultural and agricultural sectors. There are three types of historical evidence that points to factors behind the movement in relative wages. First, there were changes in the *hukou* system of registration of urban and rural population and the restrictions on their movement.[20] Second, there were changes in the return to human capital. Lower

[19] We also note that there is very little data on monopoly markups in the non-agricultural sector. The only direct evidence we are aware of is the study by Dong and Putterman (2000) who argue that monopsony in the pre-reform industry was a significant impediment to structural transformation. They calculate the difference between the marginal product of labor and wages, including welfare benefits and subsidies, in Chinese state industry and find that the mean gap was 169 percent and the median gap was 189 percent for 1952-1984.

[20] While the origins of the *hukou* system can be traced to 1951, Nolan and White (1984) argue that the measures to control migration started to be effective after 1955. Cheng and Selden (1994) provide a detailed account of the origins of this system and Chan and Zhang (1999) a comprehensive history of the *hukou* system. See also Liu (2005) who discusses

returns to education manifest themselves in the lower non-agricultural wage and a lower mobility distortion.[21] Finally, there were policies aimed directly at relocating workers such as the massive forced resettlement of urban population to the countryside in 1961-62 (Lardy 1987b, p. 387) or sending about 18 million urban youth to villages during Cultural Revolution and their gradual recall back to the cities (Wu 1994). We use the wage ratio as our proxy for the labor mobility distortion.[22]

5.4 Sectoral investment prioritization: Non-consumption component of the capital distortion

The fourth set of important policies affected the allocation of capital across sectors by favoring or disfavoring capital allocation in agriculture. These policies result in the non-consumption component of the capital distortion and we proxy them using the data on state investment in agricultural infrastructure construction (Sheng (1993a, Table 6.4) and Zhang and Zhao (2000, Table 9)). Sheng (1993a, p. 120, p. 132) describes this variable as a "value indicator of capital construction" covering such directly related to agriculture projects as harnessing rivers, constructing water conservancy facilities, meteorological projects and capital construction in agricultural scientific research. As the first component of our direct measure we use agricultural infrastructure construction spending as a share of non-agricultural value added. To evaluate the effect of infrastructure spending on the non-consumption component of the capital distortion we need to compute the rate of return to capital in agriculture. To do this, we use the perpetual inventory method to construct a proxy for agricultural capital assuming that all the

hukou conversion process as a crucial aspect of rural–urban migration whereas recruitment by state-owned enterprises was the main channel for individuals in rural areas to obtain an urban *hukou* during the 1960s and 1970s.

[21] Fleisher and Wang (2005) argue that three factors were behind the decline in the wage gap: (1) decreased differential between traditionally good (for example, high paying employers owned by the central government) and bad jobs (Zhou 2000); (2) decreased differential in pay between workers who differ in schooling within jobs; (3) discrimination in the assignment of college graduates to jobs in favored occupations, industries, and geographical locations, as evidenced, for example by sending high school graduates to rural jobs (see discussion in Zhou and Hou 1999).

[22] These data have their limitations since wages were not set competitively, and some of the remuneration was in non-monetary form, with a portion of it included returns to land and investment. The only other source of data that we are aware of is Bai and Qian (2010) which implies a very similar path of relative wages for the overlapping post-1978 period.

investment comes from infrastructure construction only. We then construct the rate of return to agricultural capital as the production elasticity times the ratio of value added to capital. The proxy for the capital distortion is then the ratio of returns to non-agricultural capital (fixed at its 1953 value) and the rate of return to agricultural capital coming from infrastructure spending.

The proxy we use is consistent with the historical evidence that the economic policies in terms of capital allocation prioritized the industrial sector as shown, for example, in the classification of the evolution of China's development strategies by Cheng who ranks the sectoral priorities (1982, Table 9.3).[23] It is interesting to note the increase in the non-consumption component of the capital distortion during the Great Leap Forward. This can be accounted for by the policy of "walking on two legs" which represented "a sharp break with the industrial policies of the First Five-Year Plan" in which the high capital intensity industry was developed alongside the small-scale, labor intensive plants such as backyard furnaces (Eckstein 1977, p. 124). "Agriculture First" strategy most significantly increased chemical fertilizer production, electricity allocation, and the production of small agricultural implements (Eckstein, 1977, p. 60) which can account for the decline of the non-consumption component of the capital distortion.[24] An additional element was the development of the "Third Front", a massive construction program in the inland provinces of the entire industrial base that would not be vulnerable to the attacks by the Soviets or Americans.[25]

[23]The First Five-Year Plan (1952-1957) placed the "overwhelming allocation of investment resources to industry" and production of capital goods (Lardy 1987a, p.158). Lardy (1987a, p. 158) and Eckstein (1977, p. 188) give details of investment allocation to industry and agriculture to also argue about the low priority of agricultural investment.

[24]The decline in the non-consumption component of the capital distortion in 1960s and 1970s is consistent with the argument of Perkins (1991, p. 486) who concludes that the period of 1966-76 was very similar to the original 1950s vision of the First Five-Year Plan and Lardy (1983, p. 144) argues that this period was marked by "proportionally reduced agricultural investment, a decline in the volume of agricultural credit".

[25]See Naughton (1988) for a detailed discussion of the industrial policies under the Third Front.

5.5 Investment prioritization: Investment distortion

The fifth set of policies are those that affected investment accumulation. We construct the proxy for these policies for 1953-1973 based on direct evidence from the unpublished Ph.D. dissertation of Barry Naughton "Savings and investment in China: a macroeconomic analysis" (Naughton, 1986). In this work, he analyzes the theory of investment cycles in socialist economies and argues that the only factor that can quantitatively and empirically account for the "extreme investment instability" during this period is the interaction of the central and local governments. He provides evidence that China was unique among socialist economies as a large proportion of investment allocation was done by the local and provincial governments. The investment cycle is driven by the change in the bargaining position between the local governments who find it easier to push for high investment during the periods of abundance of consumer goods and the central government who during the time of shortages limits the appetites of the local governments.[26]

Furthermore, Naughton (1986) creates two indices that capture the degree of such shortages. The first index is based on the unique dataset, available only for China and not for any other centrally planned economies. After the leadership change in 1978, the Chinese economists were encouraged to criticize economic policy under Mao; as a part of this campaign the data on the difference between the supply of consumer goods and consumers' purchasing power and resulting shortages were released. We use this "general scarcity indicator" index from Table III-2, Column 4 in Naughton (1986).[27]

The second index he constructs is based on the consumers' asset holding using income and saving data to measure excess money holdings of the population whereas the consumers choose to hold higher money balances as opposed to savings during the time

[26] More broadly this model is related to the classical work by Kornai (1992) who argues that investment cycles are prevalent among socialist economies and are driven by capacity constraints.

[27] While both this indicator and the ratio of the free market prices relate to shortages they are different. The former measures the degree of the overall shortage and hence implicit forced savings – the component relevant to the intertemporal distortion. The latter measures the degree of relative shortage of agricultural to manufacturing goods. See also the literature on transition and comparative economics which stresses the principal role of the political economy and policies in large and abrupt growth and macroeconomic changes (for example, see surveys in Roland 2000, 2002).

of shortages consistent with the model of search for scarce consumer goods. We thus use the monetary shift index Table III-2, Column 4 in Naughton (1986). These two indices show remarkable similarity when properly rescaled (Figure III-1). Summarizing, Naughton (1987) states that "The shortage index was the only time series found which predicted changes in investment: tests of agricultural production or procurement, energy supply, and foreign trade balance failed to provide any predictive power .... This test indicates that conditions on consumption goods markets have been a crucial determinant of investment fluctuations, either because planners allow investment to grow rapidly when supplies of consumption goods are abundant, or because emerging shortages in the consumption sector bring expansionary episodes to a halt."

We take the average of the two indices to quantify the investment distortion introduced by the policies of investment prioritization. The direct evidence starts in 1956 and ends in 1974 as Naughton (1986) argues post 1973 these indicators start to lose their connection with the investment distortion. For the remaining dates we have no other option than to use the measure of distortion derived from the aggregate data. We calibrate the distortion for the 1953-56 period to the average value derived from the aggregate data. For the 1975-78 period we use the values derived from the aggregate data. The investment distortion declined substantially in 1976 which may capture expectations of future changes in policies leading to economic reforms and a growth spurt following the death of Mao. We found it important to capture this decline in the investment distortion to meet the terminal conditions of our calibrated simulation.

5.6 Policies affecting sectoral TFP

Many and likely most of the economic policies during that period of China's history affected sectoral TFP. TFP is the residual that represents somewhat of a black box that captures a variety of policies and distortions. In this section we quantify the effects of the most salient policies of the political development cycle on the sectoral TFPs. We first consider several broad theoretical mechanisms through which productivity in either

sector could be influenced by the main policies, and then use more sector-specific models to calibrate the paths of TFP based on historical accounts of related policies.

5.6.1 Modeling policies affecting TFP

First, consider a basic model of incentives. An economic agent (a farmer or an enterprise) can exert effort to increase its productivity X. Higher productivity results in higher output (or profit) y. The cost of effort is not observable while the output is. The cost function is well behaved ($c' > 0, c'' > 0$). The strength of incentives is measured in the output share ξ retained by the agent. If there are no incentives, $\xi = 0$. If incentives are strong, then $\xi = 1$. The agent maximizes $\xi y - c(y)$. The first order condition is $c'(y) = \xi$. Output (and, therefore, TFP) increases in the strength of incentives:

$$\frac{dy}{d\xi} = \frac{1}{c''(y(\xi))} > 0,$$

where $y(\xi)$ is the solution to the f.o.c.

Second, consider a model of commune size. Let there be N peasant households. Each household i can exert effort e_i to increase its productivity X_i^A. Higher productivity results in higher output y_i which is combined and then shared across the households with each household getting s_i. Each household maximizes its share net of cost of effort $s_i - c(y_i)$. The cost function is well behaved ($c' > 0, c'' > 0$). The resource constraint is

$$y = \sum_i y_i = \sum_i s_i + z,$$

where z is the amount of output taken by the central government. If each household operates individually and keeps its own marginal output $s_i = y_i - z_i$, the incentives are first best (here, $\sum_i z_i = z$). Each household maximizes $y_i - c(y_i)$, hence the first order condition is $c'(y_i) = 1$. Now assume that all N households are merged into one commune, their output is combined and each household's payoff is based on the joint output y according to a sharing rule $s_i = S_i(y - z)$. The first order condition is $c'(y_i) = S_i'(y - z)$

which cannot be efficient: the resource constraint implies $\sum_{i=1}^{N} S_i'(y-z) = 1$ (this is the classical moral hazard in teams problem, Holmstrom (1982)). The symmetric sharing rule is $S_i(y-z) = \frac{y-z}{N}$, in this case the first order condition is $c'(y_i) = 1/N$. As N increases, incentives are suppressed and X_i^A growth declines. We can map the model of commune size to the basic model of incentives — by calculating the strength of incentives ξ. Under the individualistic policy, we have $\xi = \xi^R = 1$. Under the commune policy, $\xi = \xi^L = 1/N$.

The literature has three more broad classes of mechanisms that can lead to increased productivity in periods of individual incentives and lower productivity in periods of centralization. First, the relationship between soft budget constraints and lack of innovation has been studied extensively (including in Chinese context, e.g., Qian and Xu (1998)). This literature argues that soft budget constraints can lead to faster or slower TFP growth depending on assumptions about distribution of revenues and losses across contingencies. Soft budget constraints can result in overinvestment in a TFP-enhancing technology relative to second-best with underinvestment: if there are weak incentives to invest, soft budget constraints can strengthen them.

Second, there is a growing literature on U-form versus M-form hierarchy. Under U-form, enterprise from industry i located in region r reports to the industrial ministry i. Under M-form, all enterprises located in region r report to the regional boss r. The benefit of M-form is that if regional economic shocks are not too different across regions, there is a scope for relative performance evaluation and therefore stronger incentives for regional bosses. In U-form, it is impossible to compare ministry 1 to ministry 2 as they are specialized. This argument is made in Maskin, Qian, and Xu (2000). They compare industrial and regional variances and conditional variances in China and show that M-form provides better incentives — hence implying higher TFP growth under M-form.[28]

Third, as discussed by Lardy (1983) and extensively documented by Lyons (1987),

[28] Qian, Roland and Xu (2006) make a similar argument showing that M-form promotes optimal experimentation.

the Chinese development model rested upon a principle of self-sufficiency: between 1957 and 1979 it exhibited a significant tendency towards regional autarky. The restrictions on economic integration lead to non-negligible losses in economic efficiency associated with underutilization of regional comparative advantages, underuse of economies from large-scale production, as well as underaccumulation of physical and human capital. To evaluate the losses due to the underutilization of regional comparative advantages we briefly describe a model of inter-regional trade along the lines of a standard Heckscher-Ohlin model.

Let there be two regions which employ a factor N in the production of two goods. Production in both regions i of both goods j are given by production functions $Y_j^i = A_j^i \left(N_j^i\right)^\beta$ that differ only in productivity levels A_j^i. Both regions contain equal amounts of factor normalized to 1. Combining the production functions with the resource constraints yields production possibility frontiers $\left(\frac{Y_1^i}{A_1^i}\right)^{1/\beta} + \left(\frac{Y_2^i}{A_2^i}\right)^{1/\beta} = 1$. We assume symmetric comparative advantages with productivity ratios equal to a and representative consumers maximizing symmetric log utility with respect to both goods. The allocation under free trade is found by maximizing total consumption under a joint PPF with trade and yields output values of $Y_1^1 = Y_2^2 = \left((a)^{\frac{1}{1-\beta}} + 1\right)^{-\beta}$ and $Y_1^2 = Y_2^1 = (a)^{\frac{1}{1-\beta}} \left((a)^{\frac{1}{1-\beta}} + 1\right)^{-\beta}$. The restriction of self-sufficiency imposed by the central government implies autarky and both regions are directed to maintain identical production proportions. Production equals consumption and is found by intersecting the two autarky PPFs yielding symmetric output $Y_j^i = \left(\left(\frac{1}{a}\right)^{1/\beta} + 1\right)^{-\beta}$. Comparing total production in the two regimes yields an estimate of total TFP loss $\left(1 + (a)^{\frac{1}{1-\beta}}\right)^{1-\beta} \left(\left(\frac{1}{a}\right)^{1/\beta} + 1\right)^{\beta} /2$.

Our next goal is to convert these theoretical approaches into quantitative measures of productivity changes related to specific policies. In order to do that, we briefly discuss historical narratives describing the forces which led to the most drastic changes in TFP and then describe how we calibrate the paths of TFP based on this evidence as well as additional sector-specific evidence.

5.6.2 Policies affecting agricultural TFP

The First Five-Year Plan (1952-57) was "an unusually successful program of economic development" (Lardy 1987a, p. 157). Several facts point to growth of TFP in agriculture during this period. First, the process of collectivization in China "limited the disorder and destruction of economic resources" (Teiwes 1987, p. 111). Second, more efficient methods of agricultural production were implemented. Nolan (1976) gives detailed figures and determines five such methods: (1) increase in irrigated areas; (2) increased multiple cropping; (3) afforestation; (4) improved seeds; (5) increased collection and application of organic fertilizers (see also Naughton 2007, Chapter 11). Third, the collectivization led to consolidation in the land plots that led to improvement in agricultural productivity (Spence 2013, p. 491). Finally, as shown by Kung and Putterman (1997), during this period agriculture was still effectively organized on a household basis. Despite formal collectivization of property rights, until mid-1958 individual households were still allowed on their own land plots which helped to identify their efforts and therefore address the incentive problems.

During the Great Leap Forward (1958-1962), TFP in both agriculture and manufacturing fell dramatically. One important factor that affected TFP in both agriculture and non-agriculture was worsening of incentives (Naughton 2007, p. 69; Lardy 1987b, p. 365) as monetary rewards were prohibited, free markets in the countryside were curtailed, and restrictions on the productive private farming plots were placed. The fall in TFP in agriculture is consistent with several factors. One factor was that productivity fell due to poor management of agriculture under the commune system.[29] Li and Yang (2005)[30] argue that the most important causal factors in the collapse of agricultural out-

[29] Lin (1990) discusses a variety of hypotheses and presents a view emphasizing the role of incentives in the fall of productivity. See also Donnithorne (1987, Chapter 2) for the detailed description of the evolution of the communes. Considering the negative productivity impact of the communes Lardy (1987b, p. 370) argues that the most important factor was in the poor construction and design of the irrigation projects which reduced rather than raised yields (see also Cheng 1982, p. 267).

[30] See also Kung and Lin (2003) for the province-level panel evidence on the role of excess grain procurement and iron production and Bramall (2009, p. 128-134) for an extensive discussion of the literature on the causal factors of the collapse of agricultural production and the famine.

put between 1958 and 1961 were, in order of importance: (1) the diversion of resources from agriculture; (2) excessive procurement of grain affecting physical strength of the peasantry; (3) bad weather.

Another important factor was regional self-reliance which intensified significantly after "the famine of 1959-61 demonstrated to government officials as well as to leaders of collective farms that dependence upon outside suppliers can have disastrous consequences" (Lyons (1987), p. 250). As documented by Lardy (1983) "the ideology of self-sufficiency was incipient in the formation of communes in the late 1950s... The vision of self-contained rural communities evaporated in the collapse of the Great Leap Forward experiment. ... Yet Mao remained profoundly antagonistic to the concept of specialized production based on comparative advantage. ... Mao's ideas apparently were ignored less easily after 1965... the leadership presumably ... was concerned that the war in Southeast Asia might spill over into China and ... feared a Soviet invasion in the North. The creation of regions that could survive even if cut off from neighboring provinces and regions became an official policy goal." According to Brandt and Rawski (2008): "for the pre-reform period as a whole, the "price scissors" problem, the uncertainties of securing production inputs from other administrative units, and the difficulty of horizontal coordination mentioned earlier set off a process of "suboptimization" at the local level. Local units pursued local self-sufficiency and induced "backward specialization" (Lyons, 1987). That along with dismal (road) transport resulted in a fragmented economy, a lack of interprovincial trade in final goods, and a center that had weak economic control. Furthermore, the outbreak of the Cultural Revolution ushered in a ten-year period (1966–1976) of political turmoil that further hampered efforts to promote economic integration and further obstructed regional specialization."

On one hand, the drop in agricultural TFP during the Great Leap Forward can be directly linked to a drastic increase in the size of commune. Prior to the GLF period, incentives were set at the level of the "production unit" (10-20 households), during and after the GLF period incentives were set at the level of the whole commune reaching

100-10,000 households. After GLF, the collective farm peasants were provided a two-part compensation: the "basic grain" (based on need) and the "workpoint grain" (based on work), see Ellman (1981). The ratio between basic and workpoint rewards was set at the level of the production unit. However, as argued by Crook (1975), the workpoint payments were based on "labor days" which were essentially inputs, so it was hard to measure skill and supervise effort. Wen (1993) also claims that "Due to the difficulty of supervising labor on the farms, the 'free rider' problem was rampant, malingering was frequent, and the moral foundation of the commune system was undermined." Wen also emphasizes the problem that peasants could not make resource allocation decisions — these were made centrally, further undermining productivity growth. Fan (1997) argues that centralization of these decisions remained strong during the Cultural Revolution period (1966-76), after a somewhat more decentralized period of Agriculture First (1961-65).

McMillan, Whalley, and Zhu (1989) estimate the marginal incentives of Chinese farmers and show that pre-1978 reforms the fraction of the marginal product the peasants received was about 0.3: "In the communal system as it was organized at the end of the Cultural Revolution, it was as if, on the margin, an individual worker was paid a little over 30 percent of his marginal value product." This of course resulted in major underprovision of effort: "the effective supply of labor in 1978 (taking effort into account) was about 56 percent of what it became in 1984." (McMillan et al. assume that in 1984, after the household responsibility reform, the marginal incentives were not distorted so labor supply was efficient).

On the other hand, the reforms that started in 1978 saw a quick reversal of both patterns, in particular, according to Riskin (1987): "The rural reforms can be broken down into several distinct aspects: (1) substantial purchasing price increases for farm products; (2) increased independence of decision-making authority for the collective; (3) the replacement of a policy of forced local self-sufficiency in grain with one of encouraging diversification and specialization; and (4) rapid decollectivization of the labour and

income distribution systems."

To evaluate the effects of self-sufficiency policies we use a prototype model of inter-regional trade which we describe in detail in Section 3.2 of the Online Appendix. This model identifies two key parameters that affect the losses from the policy: the specialization slope and the production elasticity. We can use regional crop data from this period from Crook (1988) to evaluate the change in the cropping patterns due to the reforms to evaluate the size of distortions prior to the reforms. We focus in particular on the differences in cotton and grain per capita production by region (following the idea of Lardy (1983) Table 2.3). Using data for 1979-84 from Crook (1988) we compute the cotton and grain yields for 29 provinces. Based on the increase in cotton yield after the reforms we can identify 15 of them (accounting for just over half of population and sown area) that substantially increased cotton yields. The average cotton/grain yield ratio for the cotton-specialized provinces grew from 0.14 in 1979 to 0.25 in 1984, while the cotton/grain yield ratio of the non-cotton-specialized provinces declined from 0.091 to 0.076. Thus, the specialization slope[31] increased by a factor of 1.79 in the cotton region and declined by a factor of 1.19 in the non-cotton region.

The other parameter that affects the losses due to self-sufficiency policies is the production elasticity with respect to factors of production. It can vary from 0.85 (if only land could not be reallocated between activities) to 0.2 (if labor could not be reallocated either). Thus, these parametrizations give a range of efficiency loss estimates due to self-sufficiency policies from 0.5 percent (average slope change, high factor mobility) to 7.5 percent (maximum slope change, low factor mobility).

However, since the decline in agricultural TFP due to increased commune size and increased regional fragmentation and the subsequent recovery due to reversal of both policies coincided in timing, it is not necessary for us to estimate their effects separately. Instead, in the baseline calibration, we can use the estimates of TFP gains over the 1978-84 period due to the reversal of both policies to calibrate the initial drop during

[31] See model of inter-regional trade in Section 3.2 of the Online Appendix.

the GLF period.[32]

Based on the historical accounts, as well as our estimates based on prototype models, we can infer that agricultural TFP grew in 1952-57, dropped dramatically around 1960 and then remained on a lower trajectory until the post-1978 reforms. We can also infer the size of the drop to be between 30 and 70 percent. For the calibration we use the conservative estimate of a one-time 30 percent permanent drop in agricultural TFP in 1960. Thus, we assume that starting from its initial 1953 level (inferred from aggregate data) agricultural TFP grew at a constant rate, then dropped 30 percent in 1960, and then continued growing at the same rate of 1.32% annually calculated such as to match the aggregate level reached in 1978.

5.6.3 Factors affecting non-agricultural TFP

Now we turn to historical evidence for manufacturing TFP. Several factors played a role in the growth of TFP in non-agriculture during the First Five-Year Plan (1952-57). First, Soviet assistance in terms of transfer of advanced technology and advisors to help operate it played an important role (Lardy 1987a, p. 178; Eckstein 1977, p. 102; Naughton 2007, p. 66; Rawski, 1979, p. 51). Second and related to the first factor, the import of the capital intensive goods and machinery (also to a large extent from USSR) played an important role in allowing the economy to operate the "frontier technology" (Naughton 2007, p.66). Third, the First Five-Year plan model was a technocratic approach with a management model that placed responsibilities on a director of enterprises, utilized technical experts, and stressed individual incentives (Eckstein 1977, p. 89-90; Selden 1979, p. 153).[33]

Several facts point to a fall in manufacturing TFP during the GLF period. First, the collapse of agricultural production led to severe shortage of agricultural materials for

[32] When data for a period are not available, one can infer effects of a policy by measuring the effects of its reversal, see e.g. Bai and Kung (2014).

[33] Another factor that affected TFP in both the agricultural and the non-agricultural sectors of the economy is the advances in basic hygiene, disease, and pest control that affected productivity and longevity (see, e.g. Spence 2013, p. 488).

textile and food-processing industries. Second, many small-scale plants such as backyard steel furnaces were exceptionally inefficient (e.g., Eckstein, 1977, p. 124).[34] Third, the Sino-Soviet split led to the departure of virtually all Soviet advisors in the late summer and early fall of 1960. This meant that a large number of capital-goods projects had to be suspended (Eckstein, 1977, p. 203; Selden 1979, p. 97).

However, there was a reversal of the manufacturing TFP fall after 1961 consistent with the general "readjustment and consolidation" policies that refocused industrial production to more specific and high productivity projects (e.g., petrochemical and fertilizer), and to a revival of material incentives (Eckstein, 1977 p. 126). The 1962-1966 period resulted in fast recovery (when a "greater reliance was placed on material incentives and rewards as a means of motivating workers in the non-agricultural sectors of the system", Eckstein, 1977, p. 61). Mao recognized that "backyard furnaces" were a mistake.[35]

Considerable reliance on material incentives during the "Agriculture First" period resulted in Mao's growing concern that it would result in "economism" and "revisionism". This concern played a major role in his decision to launch the Cultural Revolution which emphasized the role of nonmaterial incentives and reduced material incentives (Eckstein, 1977, p. 62).[36] Despite the exceptional importance of the events of the Cultural Revolution for the country, the economic implications were much more muted. The fall in manufacturing TFP in 1967 and 1968 was relatively minor, and agriculture was affected less than manufacturing. This is consistent with the conclusion of Perkins (1991, p. 482-483) that "In short, all of the worker strikes, the battles between workers and Red Guards, and the use of the railroads to transport Red Guards around the country had cost China two years of reduced output but little more, at least in the short run... the

[34]Selden (1979, p. 100) gives the following estimates for these furnaces. In July 1958, there were 30-50 thousand small furnaces, in October – close to 1 million. By October 1960, only over 3000 were still operational, and the rest shut down. He further quotes an editorial from People's Daily of August 1, 1959: "We must face the problem frankly: Last year's small furnaces could not produce iron".

[35]Mao Tse-tung, "Speech at the Lushan Conference," 23 July 1959, in Stuart Schram, ed. "Chairman Mao talks to the people," 142-43, cited by Perkins, 1991, p. 478

[36]Historians typically define the period of Cultural Revolution starting in late 1965 and ending with the convocation of the Ninth National Congress of the Chinese Communist Party in April 1969 (e.g., Harding 1991, p. 111).

contrast between the disruption caused by the Cultural Revolution and that resulting from the Great Leap Forward of 1958-60 is striking" and that "The Cultural Revolution at its peak (1967-68) was a severe but essentially temporary interruption of a magnitude experienced by most countries at one time or another." (Perkins 1991, p. 486). Naughton (2007, p. 75) reaches the same conclusion that "From an economic standpoint, the Cultural Revolution (in the narrow definition [1966-69]) was, surprisingly, not a particularly important event".

Groves et al. (1994) attribute the lack of productivity growth in 1970-78 (and its acceleration after 1978) to lack of incentives and centralization. They mention the fact that bonuses were "denounced in China as politically unacceptable in 1966" and then "revived in 1978". But they also argue that allowing bonuses was necessary but not sufficient. It was important to provide the managers with incentives to offer bonuses to the workers. Therefore, productivity growth required managers' autonomy and stakes in profits (this is related to decentralization of decision making and soft budget constraints). They provide evidence how introduction of autonomy and incentives for the managers resulted in stronger incentives for the workers and in faster productivity growth. Jefferson and Xu (1991) run a survey of entreprise managers and also find that autonomy and market orientation resulted in higher efficiency. Similar results are found in the World Bank's project of in-depth studies of twenty large state-owned firms in 1975-1984 (see Tidrick and Chen (1987) and Byrd and Hickman (1992)).

Two additional policies had a pronounced effect on manufacturing productivity: the centralization-decentralization cycle for state-owned enterprises and the Third Front movement. Lin et. al. (2013) write that "the highly centralized plan system became increasingly unmanageable because it granted little autonomy to the local and firm levels, ... dampened the incentives of both SOEs and of local governments. ... the central government recognized this problem and launched a decentralization process to correct it. In 1957 the center delegated SOEs to the local level ... reducing the share of industrial output from 40 percent to 14 percent ... This program did not succeed because radical

decentralization caused serious coordination failures ... by 1963 all large ... industrial enterprises were again controlled by the center ... A second wave of decentralization was initiated in 1970 ... the share of industrial output ... under central control dropped from 50 percent ... to 8 percent." Thus, decentralization waves in 1957-63 and in 1970-75 also contributed to suppressing productivity in the non-agricultural sector.

The Third Front movement was a massive industrial development in China's interior provinces starting in 1964 involving heavy industry, transportation and infrastructure investments motivated by geo-political considerations. The movement of industrial production away from sources of raw materials distorted production chains and development of unuseful infrastructure wasted resources, thus reducing overall manufacturing productivity. To evaluate the effects on the Third Front on non-agricultural productivity we use a two-region model of misallocation along the lines of Jones (2011). Let there be two regions with the production in each region given by identical standard CRS production functions $Y^i = A^i \left(K^i\right)^{\alpha} \left(N^i\right)^{1-\alpha}$ producing the same type of manufacturing good $Y = Y^W + Y^R$. Assume that a fraction ρ of the labor force resides in region W and that labor is immobile but the total amount of capital K can be freely reallocated between two sectors. From basic optimization we can find that the optimal share of capital to be allocated to region W is $1/\left(\frac{1-\rho}{\rho}\left(\frac{A^R}{A^W}\right)^{\frac{1}{1-\alpha}}+1\right)$. If an arbitrary share of capital x is allocated to region W then the aggregate loss of inefficiency is $\frac{Y}{Y^*} = \frac{A^W}{A^*}\rho\left(\frac{x}{\rho}\right)^{\alpha} + \frac{A^R}{A^*}\left(1-\rho\right)\left(\frac{1-x}{1-\rho}\right)^{\alpha}$.

We use this model to evaluate the reduction in manufacturing productivity due to the "Third Front" policies. According to Naughton (1988) "the proportion of total national capital construction that went to the Third Front during the ... Third Five-Year Plan (1966-70) and Fourth Five-Year Plan (1971-75) ... (were respectively) 52.7% and 41.1%." Ma and Wei (1997) based on somewhat more reliable data estimate that the western regions associated with the Third Front temporarily increased their share of total state investment in capital construction from 23% to 37% in the years 1965-71 at the expense of the eastern regions. Fan and Zou (2021) report that the provinces associated with

the Third Front accounted for 6 percent and 9 percent of China's industrial output in 1964 and 1979 respectively and for 20 percent of China's population in 1964. We use these parameters to calibrate the sizes of labor and capital inputs as well as relative productivities in the two regions to compute the losses due to misallocation.

There are two additional sources of losses however that we need to take into account. First, Fan and Zou (2021) study long-run changes in regional plant productivity and estimate that the effect of misallocation of resources on the productivity of plants in the TF area was approximately 20%. This estimate echoes Naughton's (1988) calculation that the loss in industrial productivity in Third Front plants was on the order of 10-15 percent. Second, all of the sources we have mentioned argue that there was massive waste of resources in the process of investment into Third Front projects. Thus, we can summarize the effects of Third Front policies in three main impacts: 1) 14% of industrial investment was reallocated towards western regions in 1965-71; 2) a significant part of that additional investment was wasted; 3) productivity of western plants was permanently reduced by up to 20%. We compute the combined loss due to all three impacts.

The direct effect on productivity plays the largest role accounting for 2.2% loss in the long run. The effect of waste gradually reaches 1.5% in 1971 and then diminishes back to zero over time. The effect of reallocation also reaches approximately 1.6% in 1971 and then gradually falls back to zero. Thus, the overall loss in industrial productivity due to Third Front policies reaches a peak of 5.1 in 1971 and then falls off to 2.2 in the long run, with the average effect over the period 1964-78 being approximately 3.8%. We use these estimates to calibrate a drop in manufacturing TFP due to Third Front policies. We assume these losses were relative to the assumed trend in manufacturing TFP in 1965-78.

From these consdiderations we can infer that manufacturing TFP grew rapidly in 1952-57, declined below trend by approximately 30 percent in 1958-61, recovered back to trend in 1961-66 and then grew slowly until 1978. Given the initial and terminal

levels of non-agricultural TFP constructed from aggregate data, we approximate this narrative by assuming an identical growth/decline rate for the 1953-66 period such as to hit the trend level in 1966. From the 1966 trend level we impose the estimated effects of the Third Front and of decentralization from 1970 onwards which last all the way to the 1978 terminal level as shown in Figure 2.

Although our measures are on purpose very broad in capturing the aggregate behavior of TFP in this period, we can link the calibrated changes in agricultural TFP to policies regulating centralization of decisions (size of communes) as well as self-sufficiency policies, and changes in non-agricultural TFP to weakness of workers' material incentives and overall disorganization due to implementation of left-wing policies as well as specific policies such as two decentralization waves and the Third Front movement.

5.7 Summary

Our quantification of the sectoral productivities and components of distortions gives us all the exogenous variables necessary to construct a path for China's economy in the pre-reform period.[37] In Figure 2, we plot the paths of the sectoral TFPs and distortions that reflect the most important policies of the political development cycle that we discussed. Accounting wedges that are needed to fully account for the aggregate data are also depicted for reference.

6 Analysis of the policy development cycle in the pre-reform period

We now turn to describing the key quantitative driving forces of the policy cycle on growth and structural transformation during the whole pre-reform period and its important subperiods.

[37] The ratios of sectoral net exports to value added, defense spending to non-agricultural value added, as well as population and labor force growth are all measured directly in our dataset and taken as given in the model.

Figure 2: Distortions calibrated from direct evidence

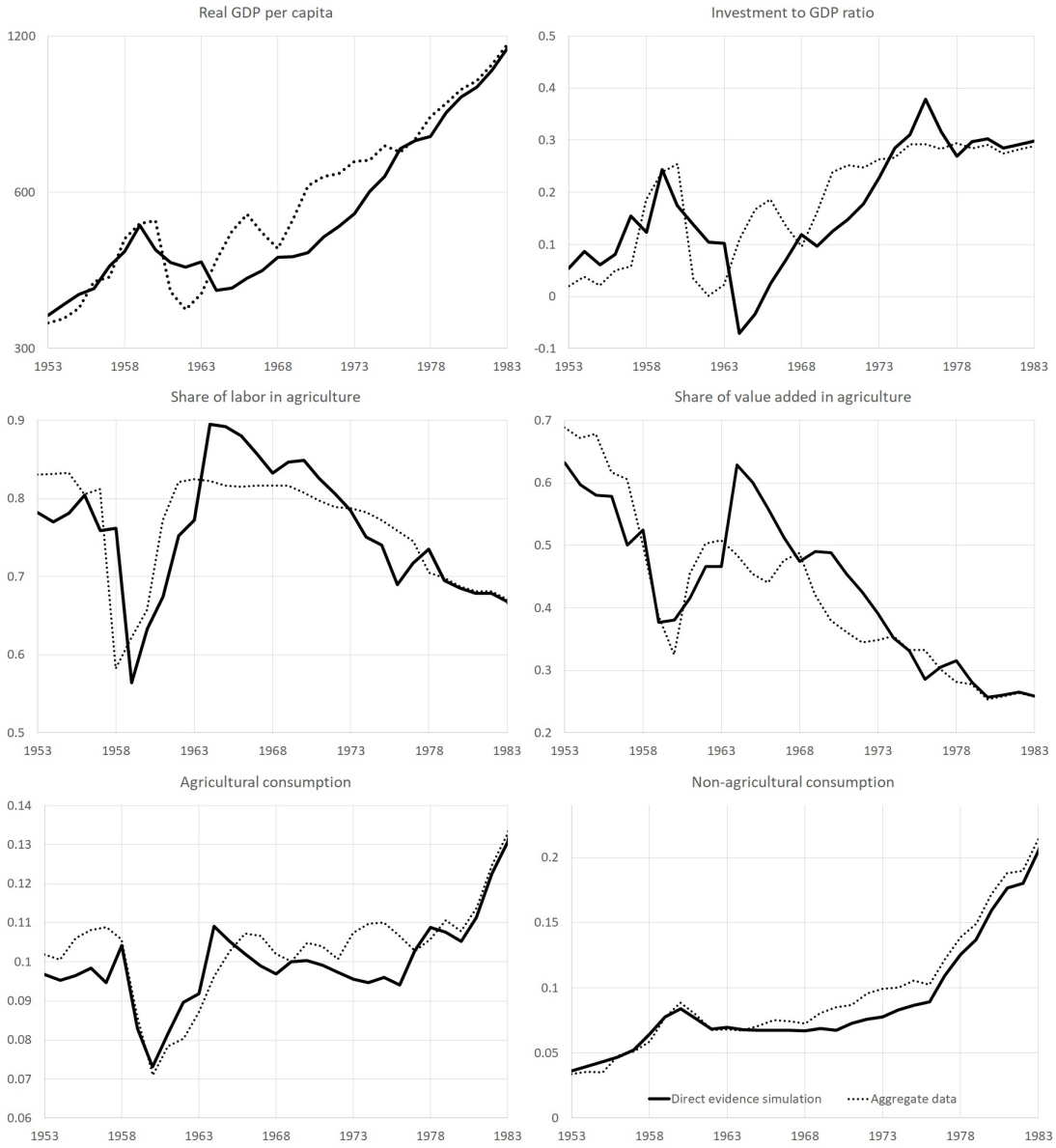

Figure 3: Simulation from direct evidence

6.1 Simulating the effects of policies

In the previous section, we described in detail modeling and quantification of the effects of the most important policies of the political development cycle on the sectoral TFPs and distortions. We now compute the model based on this direct evidence. The paths of simulated GDP, investment, labor share, value-added share, and consumption (compared with aggregate data) are shown in Figure 3.

As is evident from Figure 3, the simulation correctly captures the main movements in real GDP, investment to GDP ratio, the shares of labor and value added, and consumption in the two sectors. More specifically, the model explains a) the rapid acceleration of economic growth during the First Five Year Plan of 1953-57; b) the industrialization effort manifested by the investment boom and the movement of labor and value added out of the agricultural sector, as well as the corresponding economic decline during the Great Leap Forward of 1958-61; c) the reversal in all the variables during the Agriculture First policy of 1962-66; d) the economic slowdown and movement of value added towards agriculture in the early years of the Cultural Revolution (1967-70); e) the acceleration of economic growth and the shift of labor and capital inputs towards the non-agricultural sector during the premierships of Lin Biao (1970-72) and Deng Xiaoping (1973-75).

6.2 The right-wing and the left-wing policy packages

Table 1 shows stark differences between periods of right-wing and left-wing policies regarding the behavior of calibrated distortions and TFP. Generally, left-wing policies led to the reduction of the consumption and the production components of the labor distiortion, while the sectoral TFPs worsened. The right-wing policies, on the other hand, increased the consumption and the production distortions while the TFPs, the non-consumption component of the capital distortion and the investment distortion significantly improved.

The debate that generated the policy cycle can be described as focusing on four main questions. First, how much resources to divert from consumption towards investment?

Historical evidence indicates that the goal of industrializing as fast as possible was shared by both right-wing and left-wing policy-makers. The policies to achieve this goal focused on diverting as much resources as possible to investment through central planning means. This policy resulted in overall scarcity of consumption goods and resulted in the investment distortion in the calibrated model as we discussed at length in Section 5.5.[38]

The second question faced by the policy-makers was what type of consumption to sacrifice more, or in which proportions to sacrifice agricultural and non-agricultural consumption. Left-wing policy-makers wanted to sacrifice mainly agricultural consumption, while right-wing policy-makers wanted to sacrifice less of it. The main left-wing policies in this context were rationing and procurement of agricultural goods. In the calibrated model rationing appears in the consumption component and procurement appears in the production component of the labor distortion, as we discussed in Sections 5.1 and 5.2.

The third question was what type of capital to build up more. This policy is reflected in the relative importance of construction expenditures and shows up in the non-consumption component of the capital distortion in the calibrated model, as we discussed in Section 5.4. The right-wing policymakers wanted to relatively shift resources towards heavy industry compared with the left-wing.

Finally, an important fourth question was how to organize production and incentivize workers and peasants. The left wing of the party wanted collective production and centralized control, while the right wing argued for some decentralization and a focus on material incentives. We have used historical accounts of these policies to calibrate the productivity drop in agriculture associated with the expansion of communes in the country-side, and the swings in non-agricultural TFP around the long-run trend associated with excesses of the Great Leap Forward.

Thus, in our baseline calibrated model we constructed an economy where only the

[38]The changes in the investment distortion are quite noisy, so the breakdown over the policy cycle reported in the last line of Table 1 is very sensitive to small changes in periodization. One robust finding is that the investment distortion was gradually reduced over the whole pre-reform period promoting the industrialization goal.

	1953-78	Ring-wing	Left-wing
Manufacturing TFP	51	76	-25
Agricultural TFP	9	17	-8
Consumption component	-24	83	-107
Production component	16	41	-24
Mobilility component	15	0	15
Non-consumption component	-79	-81	2
Investment distortion	-16	-18	2

Table 1: Changes in distortions and TFPs (log points).

distortions and sectoral TFPs linked to salient policies, that we empirically estimate and quantify, play a role, and other fluctuations in distortions and TFPs are absent. This is exactly the direct approach as described by Restuccia and Rogerson (2017) applied to studying the causes of misallocations. This approach also differs from the wedge accounting methodology as it leaves out many other important policies and distortions that were present and thus does not fully account for the data. Our next goal is to quantify the effects of both policy packages and of the policy development cycle.

We therefore identify two policy packages as follows. The left-wing policy package can be summarized as focusing on reducing consumption and production distortions and thus extracting resources from agriculture at the cost of reduced TFP. The right-wing policy package can be described as focused on fast TFP growth and capital accumulation keeping the barriers to labor allocation in place. We do not include changes in the investment distortion into any of the policy packages because both policy wings were in agreement on the industrialization goal.

6.3 The effects of the right-wing and the left-wing policies

To evaluate the effects of these policy packages, we construct and simulate two alternative paths of China's economy: 1) the right-wing policy package is adopted for the whole 1958-78 period, 2) the left-wing policy package is adopted for the whole 1958-78 period.

To simulate these paths we need to understand what would have changed in the behaviors of policy distortions and TFPs under each scenario.

As we just established, the right-wing policy package would have seen continued growth of TFP after 1958 without a reduction in the consumption or production components of the labor distortion. As an approximation of this policy package, we assume that TFPs in both sectors grow at constant rates from 1958 onward towards their post-reform levels and both components of the labor distortion remain fixed at their 1958 level until 1983. For transparency, we assume that all the remaining distortions follow the same paths as in the baseline calibration.

For modeling the effects of the left-wing policy package we assume that both the consumption and production components of the labor distortion decline in 1959 by half the size of their maximum drop during the GLF period, and stay at this reduced level until 1983.[39] We assume that the non-consumption component of the capital distortion remains fixed at its 1958 level until 1983. We assume that the decline in agricultural TFP we calibrated based on direct evidence – was the same as would have happened as a result of a left-wing policy package and was not reversed until the post-1978 reforms. We similarly assume that manufacturing TFP drops by half its calibrated GLF decline and then grows at a constant rate preserving its lower level between 1959 and 1978. In both scenarios we keep the path of the mobility and investment distortions the same as in the calibrated benchmark.

The baseline and the two alternative paths of TFPs and distortions are illustrated in Figure 4. The paths of the economic main variables of interest for all three scenarios are shown in Figure 5.

We find that each of the two alternative paths is better - both in terms of welfare and GDP growth - than the baseline simulated path of the economy vacillating between

[39]Had we assumed that under the left-wing policy package both the consumption and production components dropped all the way to their lowest GLF levels, the left-wing policy path would have been a lot better than the right-wing policy path both in the short and long run. The reason we think such a path to be unrealistic is that it implies a significant uniform drop in agricultural consumption, which given enough cross-sectional food consumption inequality would have lead to famine of much bigger proportions than that observed during the GLF period.

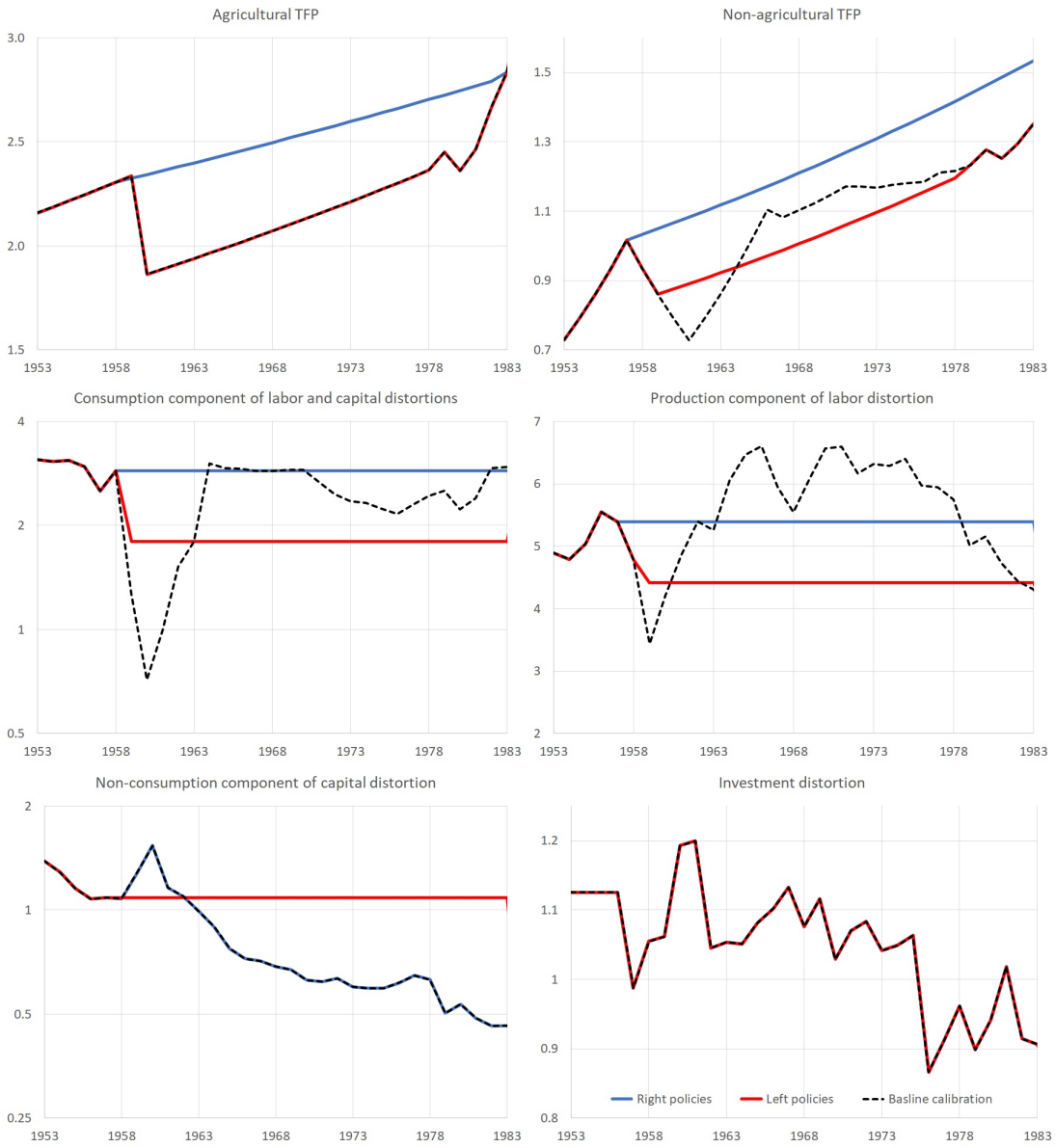

Figure 4: Alternative paths of distortions

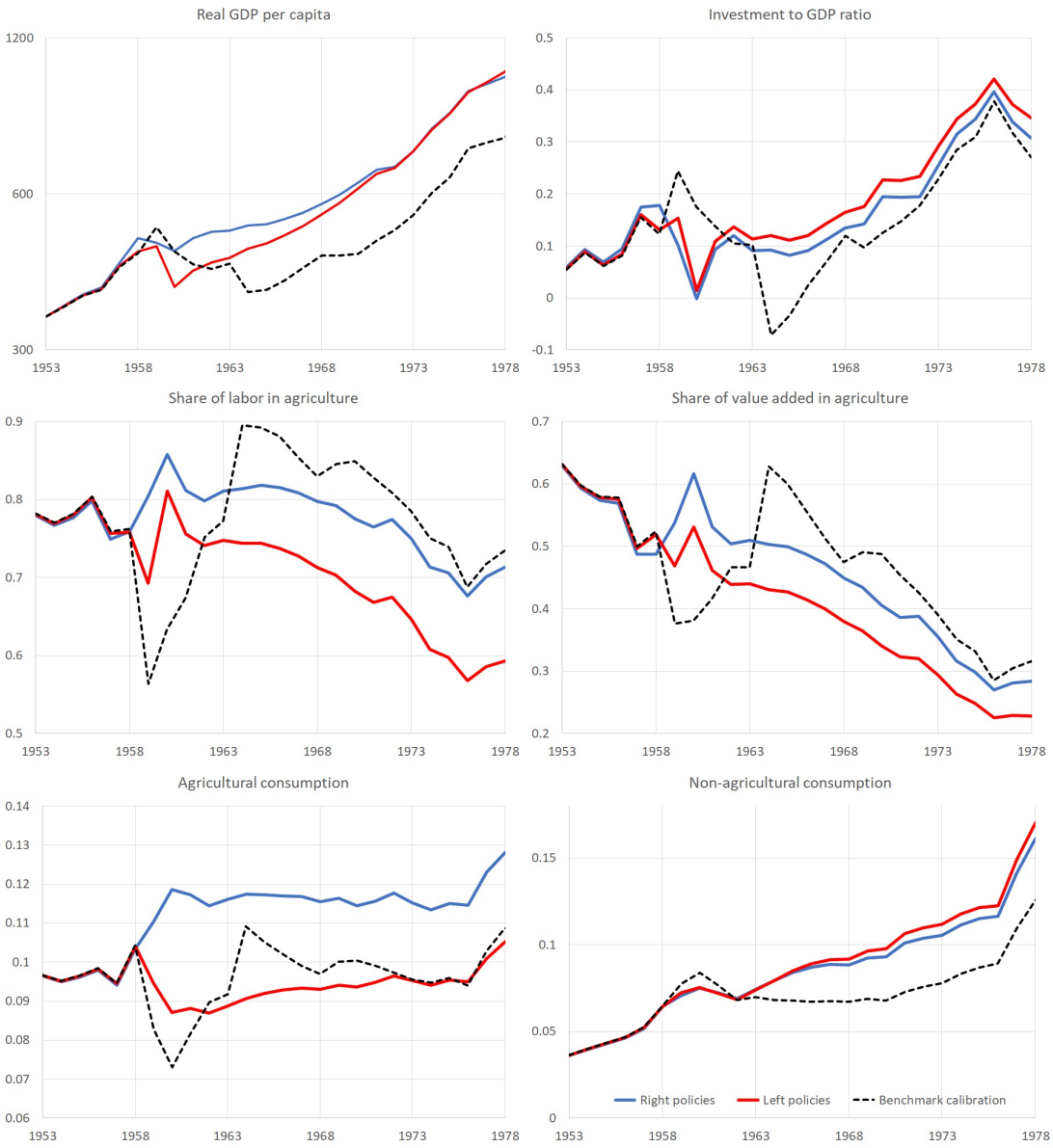

Figure 5: Simulations of alternative policy packages

the right-wing and the left-wing policy. The paths of GDP per capita under both right-wing and left-wing policy paths immediately exceed the benchmark calibration and the gap quickly reaches 20 percent for right-wing policies and 15 percent for left-wing policies. Both policy paths exceed the benchmark in investment as share of GDP and in capital accumulation. The main difference between them is that the left-wing policy path prioritizes structural transformation towards non-agricultural production and consumption at the cost of agricultural development while the right-wing policy prioritizes agricultural consumption through slower structural transformation. Both achieve similar increases in investment, GDP and welfare starting from 1970. The left-wing package achieves bigger structural transformation at the short-term cost of GDP and welfare in the 1958-65 period.

The most remarkable finding is that each of the two stable policy paths are significantly better than the actual path of the economy. The reason is that constant shifts between the two policy packages perpetuated the short-term costs of left-wing policies while failing to achieve their main goal of a lasting reduction in distortions.

7 Analysis of the post-1978 reforms

While the focus of our paper is on the pre-1978 period, this section provides an overview of the 1978-2012 period. We refer the reader to the working paper Cheremukhin et al. (2015) for the comprehensive treatment of this period with the detailed description of the data, references to historical evidence, discussion of the policies, and a number of other calculations. The primary area on which we focus in this section is the comparison of the effects of pre-reform policies with those implemented during the reforms. More broadly, the joint analysis of the pre-1978 and post-1978 periods allows us to provide continuity of the treatment of both periods and relate to the recent work on the long and persistent effects of history such as Nunn (2008) and Dell (2010).

For perspective, in Table 2 we use aggregate data to compare the changes in TFPs

and distortions for four subperiods: Mao 1957-77, Deng 1977-89, Jiang 1989-2002, and Hu 2002-2012. We can infer from the Table that the main reforms promoted by Deng and subsequent leaders were fast TFP growth combined with gradual reduction in production and consumption components of the labor distortion. In other words, these policies led to the changes that resembled the best results of both the right-wing and the left-wing policies of the pre-1978 period.

We now briefly discuss the associated policies. The growth in agricultural TFP in the 1980s was due to agricultural market liberalization, scaling down of production teams, increased private incentives, and the transition from collective farming to the household responsibility system. In subsequent periods further market liberalization and price reforms, as well as adopted technological progress and improvements in land contracting and ownership laws, kept agricultural productivity growing.

The growth in manufacturing TFP under Deng was a result of reduced state procurement of investment goods, decentralization of authority over production and investment, increased emphasis on consumer goods manufacturing, introduction of a dual-pricing system and contract management responsibility system. These initial pro-market reforms were continued with the expansion of township and village enterprises, expansion of credit cooperatives, gradual market liberalization, marketization and corporatization of state-owned enterprises followed by their partial or full privatization.

The overall decline in the consumption component of the labor distortion was associated with price liberalization and removal of controls in the markets for consumer durables, energy and housing. The further decline in the consumption component of the labor distortion is associated with reduced rationing of food (primarily grain) in the pre-2000 period, and with stricter grain import controls imposed during WTO accession in 2000-2006.

The overall decline in the production component of the labor distortion is due to the substantial decline in monopoly markups in the non-agricultural sector associated with de-monopolization and privatization of the non-agricultural sector, as well as the

	Mao	Deng	Jiang	Hu
Manufacturing TFP	20	36	64	46
Agricultural TFP	-13	44	45	49
Consumption component	-21	-15	-47	0
Production component	5	-49	0	-46
Mobilility component	5	5	33	13
Non-consumption component	-69	-16	-10	21
Investment distortion	-28	14	-7	-16

Table 2: Changes in distortions and TFPs (log points).

gradual elimination of procurement of agricultural goods.

To understand the scale of these reforms we compare them to the pre-reform period. We envision a counterfactual path of the economy if Deng's reforms were implemented starting in 1958. For that, we import the key parameters of reforms, namely, TFP growth in both sectors and the gradual reduction in consumption and production components of the labor distortions such as to reach their levels achieved in 1989 – by 1978, keeping all the other distortions exactly like in the benchmark calibration.

Figure 6 shows the results of the simulation. Deng's policy package substantially outperforms not only the baseline but both the right-wing and the left-wing policy packages we simulated and showed in Figure 5. Compared with the benchmark GDP per capita of 785 international 1990 dollars in 1978, Deng's policy package achieves 2000 dollars per capita while the left-wing and right-wing packages each achieved only 920 dollars per capita. Compared with barely any movement of labor out of agriculture under both the benchmark (2 percent) and right-wing policy package (3 percent), the left-wing package transfers 14 percent of the labor force from the agricultural to the manufacturing sector, and Deng's policy package nearly doubles that by transfering 26 percent of the labor force. Finally, Deng's package improves welfare substantially: consumption of agricultural goods per capita grows 30 percent and consumption of manufacturing goods per capita increases more than threefold.

To summarize, while both stable right-wing policies or stable left-wing policies would

Figure 6: Simulation of Deng's policy

have notably improved the well-being of citizens compared with the economy with a policy cycle, a hybrid policy combining some of the elements of both policy packages would have done much better.

We now discuss an important qualification to this analysis. We used the same model as for pre-1978 to analyze the post-1978 period. However, the economy has changed significantly and hence the assessment of what we call Deng's policy package may be derived from a sufficiently different model. Rather, the results in this section provide a useful benchmark of what the effects of using the best of both the left-wing and the right-wing policies and eliminating the costly cycle might have been.

8 Sensitivity Analysis

Here we provide an extensive sensitivity analysis of our results. We consider how our main findings are affected by: a) changes in eight of the parameters of the model; b) eleven judgement calls that we made while calibrating the model based on direct evidence; c) five decisions made while constructing the data; and d) three judgement calls made while constructing counterfactual paths of distortions and TFPs.

We vary each of the eight model parameters $\{\alpha_{K,A}, \alpha_{K,M}, \alpha_{N,A}, \alpha_{N,M}, \eta, \gamma_A, \delta, \sigma\}$ with a standard deviation of 10 percent. The eleven judgement calls which set up the direct evidence calibration include the initial levels of agricultural and non-agricultural TFP, the initial and terminal levels of the consumption and production components of the labor distortion, of the non-consumption component of the capital distortion, and of the investment distortion, as well as the size of the drops in agricultural and non-agricultural TFP. We vary parameters of the TFP calibration with a standard deviation of 5 percent, the parameters of the investment distortion with a standard deviation of 3 percent, and the remaining parameters with a standard deviation of 10 percent.

We consider the effects of five alternative ways to construct the data: 1) indexes of agricultural and industrial goods prices advocated by Young (2003) instead of sectoral deflators; 2) farm capital from Tang (1984) instead of sectoral capital series from Chow (1993); 3) alternative weighting of the non-agricultural sector in GDP based on 2000

relative prices instead of 1978 prices; 4) using the investment deflator constructed by Perkins and Rawski (2008) instead of the GDP deflator; 5) assuming variable depreciation as in Holz (2006) instead of a constant depreciation rate. Finally, we vary the sizes of drops in non-agricultural TFP, the consumption and production components of the labor distortion during GLF in our counter-factual simulation for the left-wing policy package with a standard deviation of 10 percent.

All of these alternative assumptions for parameters, the calibration, data construction and counter-factual definitions are at least as large as and often exceed the true uncertainty a researcher might have. Table 3 shows how these uncertainties affect the main series of interest: TFPs and distortions, the baseline calibrated path of the economy, as well as the sizes of gains in GDP, structural transformation and welfare in all three counterfactual scenarios. Columns 2 through 6 show the average standard deviations of each series from 1953 to 1978 in each sensitivity analysis, while the last column shows for comparison the gains in GDP, agricultural labor share and welfare in each of the counterfactual exercises. It is clear from our sensitivity analysis that although one might strongly disagree on the paths of TFPs, distortions and aggregate variables in the baseline calibration, the maximum combined uncertainty from all sources that we might have around our main results does not exceed one third of the size of the measured effects. The uncertainty is noticeable, but does not change our main results or conclusions.

9 Conclusion

We argued in this paper that a political development cycle may have significant effects in a distorted economy that is undergoing a structural transformation. We singled out the case of China in 1953-1978 – one of the largest development programs in modern history – where the political development cycle was represented by fluctuations in policies between the right and the left. Our main goal of the paper was to quantify the effects of the political development cycle within a macroeconomic model while paying detailed

	parameters	calibration	data	left drop	all	gain
Manufacturing TFP	77	11	5.8	0	80	-
Agricultural TFP	40	4.8	13	0	42	-
Consumption component	40	26	14	0	49	-
Production component	85	53	12	0	102	-
GDP	6.1	8.6	5.5	0	12	-
Agricultural labor share	1.8	2.8	1.3	0	3.8	-
Welfare	7.6	10	16	0	21	-
GDP left-wing	0.7	0.7	0.4	0.8	1.4	27
GDP right-wing	0.5	0.8	0.4	0	1.2	28
GDP Deng	0.7	0.8	0.5	0	1.2	79
Ag. labor share left-wing	0.9	2.5	0.6	2.2	3.4	-14
Ag. labor share right-wing	1.0	2.4	0.7	0	2.9	-2.8
Ag. labor share Deng	1.4	2.0	0.8	0	2.8	-20
Welfare left-wing	4.0	5.0	1.7	6.4	9.7	29
Welfare right-wing	4.3	6.3	1.8	0	8.5	30
Welfare Deng	5.0	5.5	2.3	0	8.6	81

Table 3: Sensitivity of results to main assumptions (log points).

attention to historical, institutional, and political context of the period.

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