# Do Crises Shape the Economic Structure?*

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**Abstract**

We study how crises affect the pace of structural transformation. Using data on 102 banking and sovereign debt crises across 79 countries, we document a persistent reallocation toward agriculture and away from services. We develop an open-economy model of structural transformation to quantify the roles of income, relative prices, trade, and distortions. Standard income and price effects explain little of the observed reallocation, while trade and persistent labor and demand distortions play a central role. Solving for the model's equilibrium transition, we find that a single crisis delays structural transformation by about seven years on average. We also find that the same post-crisis changes in fundamentals and distortions lead to smaller delays in structural transformation when they hit poorer economies, largely because of differences in sectoral trade openness across stages of development.

*Keywords*: financial crises, structural transformation, sectoral reallocation, international trade, economic growth.

*JEL classifications*: F41, G01, O14, O41, L16.

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# 1 Introduction

Economies change structure as they develop, moving activity out of agriculture and into manufacturing and eventually services (Herrendorf, Rogerson and Valentinyi, 2014). The pace at which they do so varies significantly. Some economies follow a long industrialization phase, while others move into services earlier in their development (Rodrik, 2016; Huneeus and Rogerson, 2020). Emerging economies are also hit by financial crises far more often than rich ones, and those crises leave deep and lasting marks on aggregate activity (Aguiar and Gopinath, 2007; Cerra and Saxena, 2008; Reinhart and Rogoff, 2009). If crises also leave lasting changes in an economy's structure, then they are not just a source of volatility but could also be a force that shapes the path of development itself. Which way crises should push structural change is not obvious *a priori*. One view holds that crises cleanse the economy, forcing resources out of unproductive uses and into better ones (Schumpeter, 1942; Caballero and Hammour, 1991), which could accelerate structural change. Another holds that crises do lasting damage to economic activity (Stadler, 1990; Queralto, 2020), which could delay it. Systematic evidence across countries and sectors has been scarce.

In this paper, we study whether crises slow down or accelerate structural change. We first provide systematic evidence on sectoral reallocation across agriculture, manufacturing and services after crises. We then interpret this evidence through a workhorse model of structural transformation, which we extend to a small open economy with distortions in input, consumption and trade decisions. We use the model to identify the drivers of post-crisis reallocation and to quantify the contribution of each channel. Finally, we solve for the model's transition dynamics and simulate a crisis that reproduces the post-crisis dynamics we document in the data. This allows us to quantify the long-run impact of a crisis on the development path, and how it depends on the stage of development at which the crisis hits.

We find that crises slow down structural change: they pull resources toward agriculture and away from services, relative to manufacturing. Standard income and price effects explain little of this reallocation, while trade and distortions in labor and demand play an important role. In the model, a typical crisis in our sample delays structural transformation by about seven years of development. The same crisis, that is, the same shocks to fundamentals and distortions, has different consequences at different stages

of development. Because trade shapes how changes in sectoral productivity translate into reallocation, a crisis that shifts resources toward agriculture in a rich, open economy shifts them less in a poor one, and may even shift them away from agriculture.

The first part of the paper documents how economic structure changes after a crisis. Using sectoral economic activity data from 79 countries covering 102 banking and sovereign debt crises between 1950 and 2019, we show that the reallocation is large, persistent, and opposite to the usual direction of development. A decade after the onset, the agricultural employment share is about 5% higher than it would otherwise have been, with no sign of reverting, while the services employment share remains about 3% lower. Value added also shifts toward manufacturing, but employment does not.

The results are similar across alternative specifications and estimators and remain after accounting for pre-crisis trends. We also show that crises are not just a mirror image of growth accelerations. Finally, the results are robust to excluding crises followed by large post-crisis policy changes such as trade liberalizations and to comparing construction booms with and without subsequent crises.

We also find heterogeneity across levels of development and types of crises. The reallocation toward agriculture is larger the richer the economy is when the crisis hits. Consistent with this pattern, sovereign debt crises, which occur almost exclusively in emerging economies, exhibit much smaller employment reallocation toward agriculture than other crises. As we show below, our model generates this gradient through trade.

A simple back-of-the-envelope calculation suggests that the magnitudes we document are large. For instance, in an economy whose structure changes at a typical pace, the shift toward agriculture following a single crisis amounts to five to seven years of structural change, close to what we find in our quantitative model.

To understand what drives that shift and how much it delays structural transformation once general equilibrium effects are taken into account, we extend the structural transformation model of Comin, Lashkari and Mestieri (2021) to a small open economy with sectoral distortions in production, demand, and trade, in the spirit of Chari, Kehoe and McGrattan (2007) and Hsieh and Klenow (2009).

We decompose the post-crisis reallocation into four channels. First, non-homothetic preferences generate an income effect, so a contraction in aggregate consumption shifts

demand toward sectors whose demand responds least to income, such as agriculture. Second, because sectors are complements, a fall in a sector's relative price lowers rather than raises its employment (Ngai and Pissarides, 2007). Third, trade breaks the link between domestic consumption and production. Even when a sector's domestic expenditure contracts, employment in a sector can rise if its net exports increase. Finally, the wedges capture what these three forces leave unexplained. We discuss how their post-crisis dynamics may reflect several underlying frictions, including financial ones, and how, in equilibrium, the wedges also feed back into the income, price, and trade channels.

The measurement is intuitive. We identify the labor wedge from the gap between a sector's value added and its employment, so a sector whose output grows faster than its employment faces a rising labor distortion. We recover the demand wedge as the residual between observed sectoral expenditure and what the demand system predicts given relative prices and aggregate consumption. The remaining components follow from the model's equilibrium conditions, so every channel can be measured from observables.

We find that the standard forces of structural transformation (i.e., income and price effects) account for little of the reallocation. Measured relative to manufacturing, the income effect raises agricultural employment by about 4% while the fall in agriculture's relative price pushes it back by about 2%, leaving about 2% against a measured rise of about 12%. For services the two forces together point down by about 4% while the measured change is lower than 1%.

Trade is what separates the two sectors. Agricultural net exports rise slightly relative to manufacturing, adding about 2% to the reallocation toward agriculture. For services, by contrast, manufacturing net exports rise while services trade changes little, reducing relative employment in services by about 8%. The distortions are persistent in both samples. The labor wedge shifts employment out of manufacturing toward agriculture and services and does not fade over the decade, and in services a demand distortion of about 13% offsets most of the pull from trade.

The decomposition evaluates each channel at its measured value, so it tells us how much each contributes to the observed reallocation, but not how a crisis changes the economy's path through its effects on fundamentals and distortions. We therefore solve for the model's equilibrium transition to study how these changes reshape the

path of development once general equilibrium effects are taken into account.

We calibrate the model's transition to reproduce the long-run structural transformation and economic growth patterns. We then model a crisis as an unanticipated shock to fundamentals, disciplined by the post-crisis dynamics we document, and feed in the labor and demand wedges recovered from our accounting exercise. The wedges can persist in the medium run but eventually vanish, while crises can leave permanent changes in the levels of fundamentals without affecting their long-run growth rates. As a result, the economy converges to the same constant growth path, so a crisis changes when an economy reaches a given structure rather than where it ultimately ends up.

Expressed in years of structural change, a single crisis costs about seven years. The measured distortions matter for this result: without them, the services share is about 15% lower after a decade rather than about 5%, so the wedges recovered from the accounting are what hold services up after a crisis.

To see how the stage of development matters, we take the changes in fundamentals that reproduce the average crisis in the data and apply them to economies at different stages of development. Among these changes is a persistent rise in agricultural productivity relative to manufacturing. Its consequences depend on the income level, and the reason is trade. Eleven years after onset the agricultural share falls by about 5% when the crisis hits a very poor economy and rises by about 9% when it hits one near the frontier. Higher agricultural productivity lowers the relative price of food and, with complements, lowers domestic spending on it, so the share falls. In an open economy the cheaper home good also displaces imports and raises exports, so the share increases instead. Openness rises with development, which is why the same crisis can push a poor economy along its path and set a richer one back.

**Contribution and Related Literature.** That financial crises are followed by large and persistent contractions in aggregate activity is well established [see, for example, Calvo (1998); Barro (2006); Kehoe and Prescott (2007); Reinhart and Rogoff (2009); and Cerra and Saxena (2008)]. This literature has measured the cost of crises almost entirely in aggregate terms. We contribute by asking what crises do to the *composition* of activity, across a sample spanning almost 80 countries and the whole development spectrum, for which systematic evidence remains scarce.[1]

[1]Recent exceptions are Donovan, Lu, Pedtke and Schoellman (2024) and Müller and Verner (2023), which study the impact of crises on labor markets and on credit across sectors, respectively. Guntin, Ottonello and Perez (2023) study how households across the income distribution adjust consumption

A related literature studies sectoral reallocation during crises, focusing on the tradable–non-tradable margin [see, for example, Schneider and Tornell (2004); Kehoe and Ruhl (2009); Pratap and Urrutia (2012); Kalantzis (2015); de Ferra (2016); and Arellano, Bai and Mihalache (2018)]. Consistent with this work, we find post-crisis reallocation from non-tradable to tradable, especially following sovereign debt crises. However, we also document substantial reallocation *within* tradables and within services, as well as a divergence between employment and output in manufacturing that the tradable–non-tradable distinction does not capture. Moreover, the sectoral shifts we document persist for at least a decade after a crisis.[2]

We contribute to the structural transformation literature [see the reviews by Herrendorf *et al.* (2014) and Gollin and Kaboski (2023)] along two lines. First, we bring the business cycle accounting approach of Chari *et al.* (2007) to a model of structural change, so that the wedges we recover from post-crisis dynamics can discipline theories of structural transformation.[3] Second, we exploit the property that crises can leave permanent changes in the levels of fundamentals (Aguiar and Gopinath, 2007), while the economy still converges to the same long-run growth path. This allows us to measure the cost of a crisis in terms of how many years it delays structural transformation. Third, and most closely, our trade mechanism is the one studied in open-economy models of structural change. Uy, Yi and Zhang (2013) show that a non-homothetic open economy accounts for Korea's sectoral paths and the hump shape of its manufacturing share, Święcki (2017) quantifies the relative importance of the forces behind structural change including trade, and Matsuyama (1992) shows that agricultural productivity growth moves labor in opposite directions depending on whether the economy is closed or open. This mechanism is what determines the sign of the post-crisis response in our model, and because openness rises with development, it explains why the same crisis reallocates activity differently at different income levels.

during these episodes. Consistent with our work, Oberfield (2013) finds that distortions between sectors matter for the dynamics of the 1982 Chilean crisis.

[2]Our paper also connects to the literature on why emerging economies are more volatile, which emphasizes larger or more frequent financial shocks, persistent productivity processes, procyclical policy, and commodity prices (Neumeyer and Perri, 2005; Aguiar and Gopinath, 2007; Calvo, Izquierdo and Talvi, 2006; Schmitt-Grohé and Uribe, 2018; Kohn, Leibovici and Tretvoll, 2021). Casal and Guntin (2025) shows that sectoral composition explains much of the volatility gap. We study the reverse link, if crises themselves change economic structure, and the reallocation is persistent and differs systematically across levels of development.

[3]Sposi, Yi and Zhang (2018), Marcolino (2022), and Cheremukhin, Golosov, Guriev and Tsyvinski (2024) augment models of structural change with wedges to study long-run patterns in middle-income countries, the United States, and China.

Finally, a small literature links downturns directly to structural change. Howes (2022) argues that structural transformation out of manufacturing in the United States accelerates after recessions through a credit reallocation channel. Across a much larger set of countries and sectors we find the opposite sign, with crises reallocating activity toward agriculture and slowing structural change. Gatti, Gallegati, Greenwald, Russo and Stiglitz (2012) study the reverse direction, arguing that productivity growth in one sector combined with inelastic demand and slow labor reallocation can itself generate a downturn. Our finding of persistent post-crisis labor wedges is consistent with crises deepening the mobility frictions their mechanism requires. Li and Mihalache (2025) argue that as economies move into manufacturing, defaults become costlier and sovereign crises less frequent, which is consistent with the composition of our sample. Rubini and Moro (2024) finds that models of structural transformation match the cyclical properties of the data. Our results are consistent with that at business cycle frequencies while showing that, at the decade horizon, income and price effects alone leave most of the post-crisis reallocation unexplained.

**Organization.** The paper is organized as follows. Section 2 describes the data. Section 3 documents the post-crisis reallocation. Section 4 presents the model, Section 5 uses it to measure the drivers of the reallocation, and Section 6 solves the equilibrium transition to quantify the long-run impact of crises on the path of development.

# 2 Data

To systematically study sectoral reallocation during and after major crises, we combine historical data on sectoral economic activity from several sources with widely used datasets that identify and date crisis episodes. This section describes the data sources and sample selection criteria. Our baseline sample covers more than 100 crisis episodes across nearly 80 countries, spans a broad range of development levels, and exhibits the standard patterns of structural change documented in the literature.

## 2.1 Data Sources and Sample Selection

**Sectoral Economic Activity.** We use data on sectoral employment and value added from four sources: the Groningen Growth and Development Centre (GGDC) 10-Sector Database, the GGDC/UNU-WIDER Economic Transformation Database, EU KLEMS

(2023 and 2009 releases), and the OECD Structural Analysis (STAN) Database. These datasets are widely used in the literature on structural transformation and growth (Gollin and Kaboski, 2023).[4] Combining these sources, we construct a dataset covering ten disaggregated sectors: agriculture, manufacturing, construction, utilities, mining, wholesale and retail trade, transportation, finance and real estate activities, health and education (government), and other services. In our baseline analysis, we focus on three main sectors: agriculture, manufacturing, and services. We exclude mining because its share of economic activity is zero or negligible in many countries and crisis episodes. We also exclude construction from the baseline analysis because, as we show in Appendix A.2, it is primarily an investment sector. We therefore analyze it separately. Finally, we restrict the services sector to market services, excluding utilities and government services. Moreover, we use nominal and real value added to compute the country-level sectoral price indexes, which we use to measure relative prices across sectors.

**Crisis Dates.** We use the dates for banking crises and sovereign debt defaults from 1970 to 2017 provided by Laeven and Valencia (2018), extending the coverage to the pre-1970 period with sovereign default and banking crisis dates from the Global Crises Data by Country dataset, as well as additional banking crisis dates from Baron, Verner and Xiong (2020).[5] We define a crisis episode as occurring when there is either a sovereign debt crisis or a banking crisis, and we restrict our analysis to crisis dates not preceded by a crisis in the previous four years. Our baseline sample comprises 102 crisis episodes, encompassing 79 banking crises and 36 sovereign debt default crises (Table 1). Within these episodes, 13 instances involve both a banking crisis and a sovereign debt default crisis simultaneously. The majority of these episodes are observed in emerging economies. In addition, 61 of the baseline crisis episodes involved a significant output growth reversal, while 39 were characterized by a large currency devaluation.[6]

[4]We harmonize sector definitions across the datasets and chain-weight the series backwards, taking the most recent release as the base.

[5]Laeven and Valencia (2018) dataset is an update of Laeven and Valencia (2013). The Global Crises by Country dataset (https://www.hbs.edu/behavioral-finance-and-financial-stability/data/Pages/global.aspx) is developed by The Behavioral & Financial Stability Project based on data collected by Carmen Reinhart, Ken Rogoff, Christoph Trebesch, and Vincent Reinhart over several years.

[6]We consider a large output reversal episode as a crisis where the aggregate output annual growth rate is at least 1% lower two years after the crisis than it was the eight years before the crisis. Addition-

**Table 1:** Frequency and Type of Crisis Episodes

| | All | Emerging | Developed |
|---|---|---|---|
| All | 102 | 78 | 24 |
| Banking | 79 | 55 | 24 |
| Sovereign debt default | 36 | 35 | 1 |
| Large growth reversal | 61 | 40 | 21 |
| Large devaluation | 39 | 36 | 3 |

*Notes*: Table shows the number of crisis episodes in our baseline sample. We include the crisis episodes for which sectoral employment or value added data is available for all the sectors considered in the analysis.

**National Accounts and Real Exchange Rate.** To measure the income level and its dynamics we use GDP, consumption, and population data from Penn World Tables (PWT) and World Bank-World Development Indicators (WDI). Following Schmitt-Grohé and Uribe (2018) and Kohn *et al.* (2021), we define *Developed* economies as those with a GDP per capita exceeding $25,000 USD, and *Emerging* as those not meeting this threshold.[7] Finally, we use real exchange data from WDI-World Bank, Bank of International Settlements (BIS), and Bruegel.

**Trade and Input-Output Data.** To measure sectoral net exports and domestic absorption we use the World Input-Output Database (WIOD), combining its long-run, 2013, and 2016 releases. The tables separate final from intermediate use, which lets us measure both on a final-use basis, consistent with the theory. This data covers 39 of the countries in our sample over the period 1965-2014, and 41 crisis episodes. We use the trade data to quantify the role of international trade in sectoral reallocation in Section 5.[8]

**Sample Selection.** In our sample, we select countries with a population greater than 1.5 million and remove the country-year observations for which we don't have obser-

ally, a large devaluation episode is defined as one in which there is a currency crisis occurring between the year before and two years after the crisis, as defined by Laeven and Valencia (2018).

[7]Due to data availability, for the country classification we use the average GDP per capita PPP in 2017 USD from WDI for the period after 1990.

[8]The input-output data is available for a smaller and more developed set of countries than our baseline sample: it covers 23 of the 24 crisis episodes in developed economies, but only 18 of the 78 episodes in emerging economies. Appendix A.3 compares the estimated reallocation in both samples. Alternatively, we use sectoral trade data from The World Integrated Trade Solution (WITS) to extend our sectoral trade analysis to a substantially larger sample. Results show patterns are consistent to those documented here. We do not include them since for this sample trade is not measured based on final uses, thus inconsistent in the data and model.

vations in agriculture, manufacturing, construction, and services. The baseline sample includes 79 countries (52 emerging and 27 developed economies) spanning the period 1950-2019. Table A.1 and Table A.2 show the list of the countries included in our baseline sample. Figure A.3 shows the distribution of output per capita for the entire sample. When crises occur, we observe that the included episodes span a wide range of the development spectrum. The countries in our sample represent 80% to 90% of the global GDP.

## 2.2 Structural Change Patterns

We present summary statistics on the distribution of output and employment across sectors and describe the patterns of structural transformation observed in our baseline sample. These patterns are consistent with the well-established facts on structural change documented in the literature (see, for example, Herrendorf *et al.* (2014)).

**Table 2:** Sectoral Shares Distribution (%)

| | Employment | | | | Value Added | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | P25 | P50 | P75 | Mean | P25 | P50 | P75 |
| *a. All sample* | | | | | | | | |
| Agriculture | 38 | 11 | 32 | 64 | 18 | 5 | 12 | 29 |
| Manufacturing | 18 | 11 | 17 | 25 | 24 | 18 | 24 | 30 |
| Services | 43 | 24 | 44 | 62 | 57 | 48 | 58 | 68 |
| *b. Crisis window* | | | | | | | | |
| Agriculture | 38 | 13 | 32 | 66 | 16 | 6 | 13 | 23 |
| Manufacturing | 18 | 12 | 18 | 24 | 26 | 20 | 26 | 31 |
| Services | 44 | 24 | 45 | 63 | 58 | 48 | 56 | 68 |

*Notes*: Table shows the value added and employment shares in percentage for each sector. Panel (a) shows for all the sample and Panel (b) the values around crisis. Services includes wholesale and retail trade, transportation, finance and real estate activities, and other services. Shares exclude construction and mining from the total.
*Data source*: Penn World Tables, and Groningen Growth and Development Center.

**Sectoral Shares Distribution.** Table 2 displays the distribution of employment and value-added shares across sectors for the entire sample and conditional on the crisis window, defined as the period from 2 years before to 2 years after the crisis. In our sample, the average economy exhibits agriculture employment and value-added shares of 38% and 18%, respectively. On the other hand, service employment and value-added

shares are 43% and 57%, respectively. The manufacturing sector represents 18% of employment and 24% of value added. The shares of employment and value added across sectors are similar in both the entire sample and the crisis window. Additionally, there is considerable dispersion in the employment and value-added shares, particularly within the agriculture and service sectors.[9]

**Structural Transformation.** It is well documented that the shares of employment and value added for different sectors varies significantly across the development spectrum. In Figure A.1, we illustrate the structural transformation patterns observed in our dataset. Consistent with findings from other studies, the share of the agricultural sector decreases significantly with GDP per capita levels, while the share of services increases. Moreover, the share of manufacturing exhibits an inverted U-shaped relationship with income. Figure A.2 shows the structural transformation patterns for more disaggregated goods and services sectors.

# 3 Post-Crisis Sectoral Reallocation

In this section, we conduct an event-study analysis of the dynamics of sectoral reallocation during and after crises. We first document the aggregate dynamics around crises, showing that they display a persistent contraction in activity with a sharp change in relative prices consistent with previous findings in the literature. We then focus on the sectoral dynamics and find substantial reallocation of economic activity in the aftermath of crises, particularly toward agriculture. Finally, we show that the reallocation toward agriculture is robust across specifications, estimators, and samples, although its magnitude varies with the type of crisis and the level of development.

## 3.1 Aggregate Dynamics

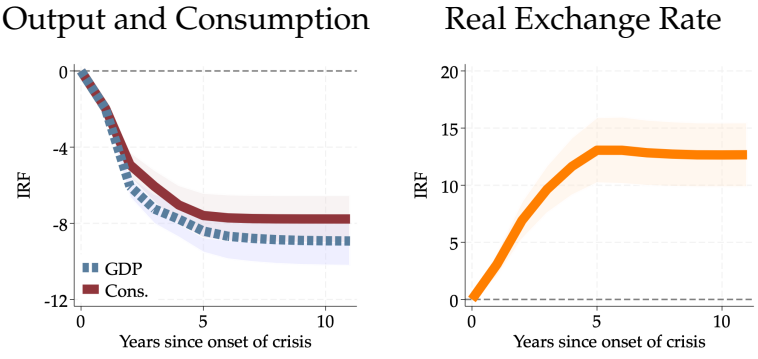
For our baseline event-study analysis we estimate the following empirical model:

$$\Delta \ln y_{it} = \alpha_i + \sum_{j=1}^{J} \beta_j \Delta \ln y_{it-j} + \sum_{h=0}^{H} \gamma_h D_{it-h} + \varepsilon_{it} \tag{1}$$

[9] Table A.3 shows the employment and value-added shares for other sector categories.

where $\Delta \ln y_{it}$ is the annual change of the variable studied for country $i$ in year $t$ (for example, GDP), $\alpha_i$ is a country fixed effect, and $D_{it}$ is a dummy variable indicating if the first year of the crisis is at period $t$. Using the estimated values of $\{\beta, \gamma\}$, we construct the impulse response function of variable $y_{it}$ to the crisis.[10]

**Figure 1:** Macro Dynamics During Crises




*Notes*: The Figure shows the IRF of aggregate real output per capita (GDP), consumption per capita (Cons.), and the real exchange (REER) for the baseline crisis episodes using empirical model (1). The impulse response shows the estimated percentage point impact on real GDP from a crisis using the estimated coefficients. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. Further details regarding the sectoral data and crisis episodes definitions are in Section 2.
*Data sources*: described in Section 2.1.

We study the dynamics of output, consumption, and the real exchange rate during the crisis. Figure 1 shows that output drops persistently by around 8% ten years after the crisis, as documented by Cerra and Saxena (2008). Additionally, aggregate consumption mirrors the persistent decline in output. The large and persistent consumption adjustments during the crisis are consistent with those documented by Barro and Ursua (2008) and others. Moreover, the figure also shows a persistent increase in the real exchange rate following a crisis, with the exchange rate remaining about 13% above its pre-crisis level even ten years later, where an increase denotes a real depreciation. This pattern is consistent with the findings of Calvo *et al.* (2006) for several Sudden Stop episodes, some of which are included in our sample.

Furthermore, Figure A.4 shows the aggregate dynamics for other types of crises: large growth reversals, large devaluations, banking crises, and sovereign debt crises. Similar

[10]This empirical specification is based on Cerra and Saxena (2008) and is also employed by Guntin *et al.* (2023) for sudden stop episodes and by Blanco, Ottonello and Ranosova (2022) to study inflation surges. The cumulative response, $\ln \hat{y}_{t+h} - \ln \hat{y}_t$, of the variable $y_t$ from time $t$ to $t+k$, where $k$ denotes the number of periods since the onset of the crisis, is given by: $\ln \hat{y}_{i+h} - \ln \hat{y}_t = \sum_{k=1}^{h} \left\{ \mathbf{1}_{\{k \leq 5\}} \gamma_{k-1} + \mathbf{1}_{\{k>1\}} \sum_{j=1}^{\min\{k-1,4\}} \beta_j \Delta \ln \hat{y}_{t+k-j} \right\}$. This response can be constructed recursively using the estimated coefficients $\{\gamma, \beta\}$.

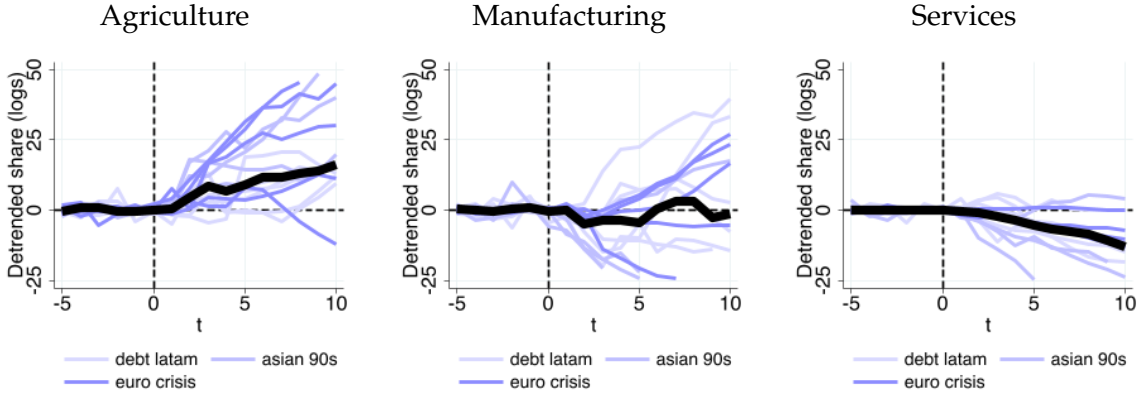
to our baseline episodes, these events exhibit a persistent decline in output of approximately 7% to 14%, while the real exchange rate increases by 10% to 26% ten years after the crisis. As expected, the largest increases in the real exchange rate are observed during large devaluation and sovereign debt default episodes (Na, Schmitt-Grohé, Uribe and Yue, 2018).

## 3.2 Sectoral Dynamics

Next, we study output and employment reallocation across sectors.

**Selected Historical Crisis Episodes.** Figure 2 shows the dynamics of employment shares around three groups of well-known crisis episodes: the Latin American debt crises of the 1980s and 1990s, the Asian crises of the late 1990s, and the European crises of the 2010s. We detrend each series by subtracting its log trend estimated over the six years preceding the crisis. Despite some heterogeneity across episodes, a clear pattern emerges. Across all three groups, the agricultural share increases following the crisis, while the services share declines. The manufacturing share dips modestly and recovers. Figure A.5 shows the same for value added. We next extend the event-study analysis to our full sample to examine these patterns more systematically.

**Figure 2:** Sectoral Reallocation during Crisis: Well-Known Episodes, Raw



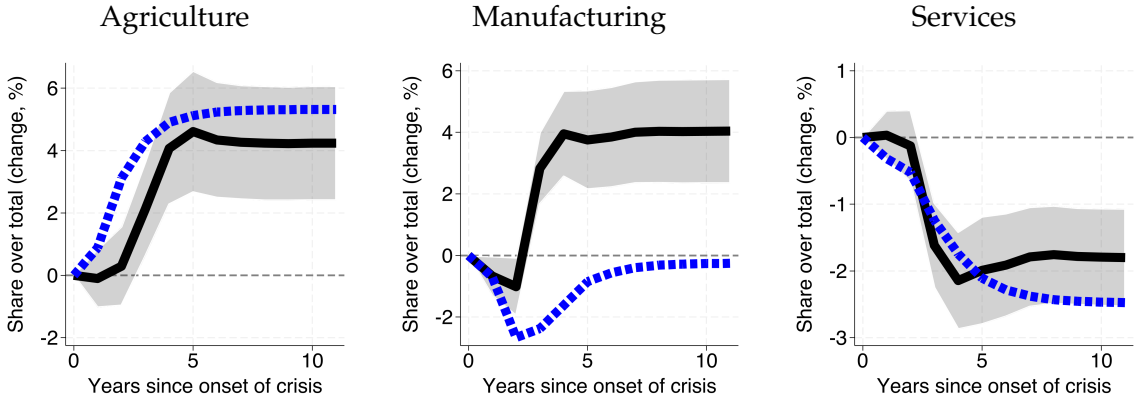

*Notes*: The figure shows the evolution of de-trended employment shares for well-known crisis episodes, in log points. We de-trend the series by subtracting the log trend from the six years preceding the crisis. The solid black line is the average across episodes. The 'debt Latam' crisis episodes include the 1980s debt crises in Argentina, Brazil, and Chile, the 1994 Mexican Tequila crisis, and the 2001 financial crisis in Argentina. The 'Asian 90s' crisis episodes include the late 1990s sudden stop episodes in Indonesia, Malaysia, South Korea, and Thailand. The 'Euro crisis' episodes include the recent European crises in Greece, Ireland, Italy, Portugal, and Spain.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Empirical Model.** We use a similar empirical model, also based on Cerra and Saxena (2008); Guntin *et al.* (2023), to estimate the sectoral dynamics:

$$\Delta \ln s_{it}^k = \alpha_i^k + \sum_{j=1}^{J} \beta_j^k \Delta \ln s_{it-j}^k + \sum_{h=0}^{H} \gamma_h^k D_{it-h} + \varepsilon_{it}^k \tag{2}$$

where $s_{it}^k$ is the employment or value added share of sector $k$ in country $i$ and year $t$, $\alpha_i^k$ is a country fixed effect, and $D_{it}$ is the crisis dummy of equation (1). We estimate the model separately for each sector and variable, and construct the impulse response from the estimated $\{\beta^k, \gamma^k\}$ as in the aggregate case, fixing $H = J = 4$. We winsorize the growth rates at the top and bottom 0.5% to limit the influence of outliers, and use a balanced panel.

**Figure 3:** Sectoral Reallocation during Crisis




*Notes*: The Figure shows the IRF of the value added share (solid line) and the employment share (dashed line) estimated using the model (2). The shadow indicates the one standard deviation error band of the value added share, computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Results.** Figure 3 shows the estimated cumulative changes in the log employment and value added shares of each sector. The reallocation toward agriculture is large and does not revert: a decade after the crisis, the employment share is about 5% higher and the value added share about 4% higher. To illustrate the magnitude of reallocation toward agriculture, a *back-of-the-envelope* calculation suggests that the shift associated with a single crisis is equivalent to a 5- to 7-year delay in structural transformation, relative to the path of an economy growing at 1% annually.[11]

[11]This calculation uses the elasticity of aggregate output with respect to the agriculture value-added/employment shares $\xi_{\text{AGR}}$ : $\ln s_{it}^{\text{AGR}} = \alpha + \xi_{\text{AGR}} \ln \text{GDP per capita}_{it} + \varepsilon_{it}$ and the values of the

Manufacturing moves in opposite directions along the two margins. Its value added share increases by around 4% and stays there, while its employment share falls by about 3% in the first two years and returns to its pre-crisis level after a decade. Output is reallocated into manufacturing without employment following it. Whether this implies faster or slower structural transformation is not clear from the manufacturing share alone, since it is hump-shaped in income and crises occur at different points along this path. However, these results are consistent with those we document in Section 3.3 using sectoral ratios relative to manufacturing, which the model predicts to vary monotonically with income.

The services share declines by about 3% in employment and 2% in value added, reflecting the reallocation toward agriculture and, to a lesser extent, manufacturing. These results suggest that crises persistently shift economic activity in the opposite direction of structural change by delaying the reallocation toward services.

In Section 4 we develop a model that allows us to identify the channels behind the observed reallocation and, through its transitional dynamics, to quantify how much crises change the pace of structural transformation, taking into account general equilibrium effects and the economy's convergence to its constant growth path.

## 3.3 Additional Results and Robustness

We next check the robustness of these patterns across specifications and estimators and report additional results, including relative price dynamics. We then study how reallocation varies with the level of development and crisis type, and whether it follows patterns similar to those observed during booms or reflects policy changes or pre-crisis dynamics. We report the corresponding figures and tables in Appendix A.

**Specification.** Our estimates are similar when we include year fixed effects (Figure A.6) and when we weight each country by its average sectoral employment or value added share (Figure A.7). Year fixed effects make some of the estimates less noisy, and weighting by average shares reduces the reallocation toward agriculture by about half.

IRF in Figure 3 $\Delta^{10}\hat{s}^{\text{AGR}}$ such that the years to undo the reallocation is years $(\text{AGR}) = \frac{\Delta^{10}\hat{s}^{\text{AGR}}}{\Delta y|\hat{\zeta}_{\text{AGR}}|}$ where $\Delta y$ is the assumed annual growth. We estimate $\hat{\zeta}_{\text{AGR}} = -0.82$ for both shares.

**Local Projections.** Alternatively, we estimate the crisis dynamics of employment and value-added shares using local projections (Jordà, 2005). We estimate

$$\ln s^k_{it+h} - \ln s^k_{it} = \alpha^{kh}_i + \beta^{kh} D_{it+1} + \gamma^{kh} \mathbf{Z}_{it} + \varepsilon^{kh}_{it+h} \tag{3}$$

where $D_{it+1}$ indicates if the first period of the crisis is at $t+1$, $\alpha^{kh}_i$ denotes the country fixed effects, and $\mathbf{Z}_{it}$ is a vector of control variables. We include the level of income, the sectoral share level at $t$, and pre-crisis share growth as control variables to ensure that our findings are not driven by pre-crisis trends. We estimate it over the window $h \in [-5, 10]$. Figure A.20 shows that the results are close to our baseline, with a more persistent decline in the manufacturing employment share. The difference reflects the lagged growth terms in equation (2), which absorb the pre-crisis decline of the manufacturing share that we document below.

**Pre-Trends.** Our controls include pre-crisis share growth, which purges the estimates of a pre-existing trend but also pins down the coefficients before the crisis, so they cannot be used to test for one.[12] Figure A.21 therefore compares our specification with one whose controls are dated strictly before the pre-crisis window, and with that specification plus country-specific trends. Under the controls dated before the window, we find no pre-trend in the employment shares of agriculture and services, and the post-crisis estimates are close to our baseline. The manufacturing employment share is already falling by about 2% in the five years before a crisis, but adjusting the estimates for that trend leaves them unchanged.

**Unpredictable Crises.** We now study how reallocation changes once we control for standard crisis predictors, using least squares weighted by the inverse propensity score (Angrist, Jordà and Kuersteiner, 2018).[13] We use GDP and private credit-to-GDP, both in levels and growth, to predict crises, with credit data from Müller and Verner (2023). Table A.4 presents the first-stage estimates. Consistent with previous work, higher private credit growth predicts a crisis (Schularick and Taylor, 2012); for sovereign

[12] At $h = -4$ the dependent variable $\ln s_{it-4} - \ln s_{it}$ is exactly minus one of the controls.

[13] For example, this approach is used by Funke, Schularick and Trebesch (2023) to study the economic impact of populist leaders. The weights are $\omega_{it} = \frac{D_{it+1}}{\hat{p}_{it}} + \frac{(1-D_{it+1})}{1-\hat{p}_{it}}$ such that $\hat{p}_{it}$ is the probability estimated from a first-stage probit: $p_{it} = P(D_{it+1} = 1 \mid \mathbf{x}_{it})$ where $\mathbf{x}_{it}$ are the set of observable predictors.

debt crises both high credit growth and low GDP growth are the key predictors.[14] Figure A.22 shows that the estimates are largely consistent with our baseline, with a smaller reallocation of value added toward agriculture.

**Employment Levels.** The shares we study can move because one sector grows or because the others shrink. Figure A.8 estimates equation (2) on sectoral employment in levels and over population, as in Ohnsorge, Rogerson and Xie (2026). Total employment falls by about 3% after a crisis, and agriculture is the only sector whose employment rises, by about 4%, while manufacturing and services fall by about 3% and 5%. The reallocation toward agriculture is therefore not an artifact of the other sectors contracting. The two lines nearly coincide because population responds little, declining by about 0.5% after a decade: the fall in the employment rate reflects employment rather than demographics.

**Construction.** We treat construction as the investment sector and exclude it from the three consumption sectors, as we show in Appendix A.2. Estimating equation (2) for construction as an additional sector, its employment and value added shares decline persistently by about 13% and 16% after a crisis, and its price relative to manufacturing falls by about 9% (Figure A.28). This represents the largest sectoral reallocation in our sample and is consistent with substantial contractions in investment during crises.

**Relative to Manufacturing.** The model in Section 4 delivers employment and value added relative to manufacturing, and that ratio is invariant to how we define the denominator of the shares. Figure A.19 reports it: relative to manufacturing, agriculture employment rises by about 6% and services value added falls by about 6%. A given move relative to manufacturing therefore does not map one-for-one into faster or slower structural transformation, as its interpretation depends on where the economy sits along the hump.

**Sectoral Prices.** Finally, we study the dynamics of sectoral prices, normalized by those of the manufacturing sector (Figure A.18). We observe a significant and per-

[14] Neither government debt levels and growth, current account and fiscal deficits, nor real exchange rate dynamics help predict banking and sovereign debt crises. If we do not control for GDP growth, government debt helps predict sovereign debt crises; however, its predictive power disappears once GDP growth is included.

sistent drop in the relative prices of agriculture and services during the crisis, by approximately 6% and 4%, respectively. This suggests that part of the reallocation to the manufacturing sector is driven by relative price changes. We use these relative price dynamics as an input to quantify the price channel in Section 5.

**Emerging vs Developed.** Figure A.9 compares crisis episodes in emerging and developed economies. The reallocation toward agriculture is considerably larger in developed economies, about 12% of employment against 3% in emerging economies. In emerging economies, instead, the manufacturing value-added share rises by about 6% while its employment share barely moves. Figure A.10 shows the aggregate dynamics for both groups.

**Income at Onset.** We also interact the crisis dummies with GDP per capita before the crisis, which replaces the binary classification with a continuous measure of development. Figure A.11 reports the response at the 20th, 50th and 75th percentiles of income at onset. The reallocation toward agriculture increases with income, from about 1% of employment at the 20th percentile to about 7% at the 75th, and the interaction is significant. We do not find a significant income gradient for manufacturing or services.

**Types of Crisis.** The reallocation is larger when the crisis involves a large growth reversal (Figure A.13). In banking crises the employment reallocation is the same as in our baseline while the value added reallocation is smaller (Figure A.14), and in crises with large devaluations the employment reallocation is smaller while the one of value added is larger (Figure A.12). In sovereign debt crises the reallocation is substantially larger, with the agriculture value-added share rising by about 12%, and employment reallocating toward manufacturing rather than away from it (Figure A.15), consistent with Arellano *et al.* (2018). Figure A.4 shows the aggregate dynamics for these episodes.

**Service Sectors.** We next look within services, at four disaggregated sectors (Figure A.17). Employment is reallocated out of finance and real estate by about 6%, and to a lesser extent out of other services and transportation, while it is roughly unchanged in wholesale and retail trade. Although reallocation across aggregate services is mild, there is substantial reallocation within the service sector itself.

**Crises and Growth Accelerations.** Crises are large aggregate movements, so we ask whether any such movement reallocates activity in the same way, comparing our estimates with growth accelerations identified following Hausmann, Pritchett and Rodrik (2005). Figure A.23 shows that the two are not mirror images: accelerations raise manufacturing employment by about 7%, while crises leave it unchanged after a decade and raise agriculture by about 5%. Thus, the reallocation we document in crises is not exactly the reverse of a boom.

**Crises and Trade Liberalizations.** Using data on trade liberalization episodes from Wacziarg and Welch (2008), we find that almost 40% (12 out of 31) of trade liberalization episodes are preceded by a crisis within the previous five years. Excluding crises followed by a liberalization leaves our estimates unchanged (Figure A.16). For episodes that are followed by one, the reallocation toward agriculture is less persistent, which highlights that large policy shifts following a crisis may lead to substantial reallocations of economic activity.

**Construction Booms.** Crises are often preceded by a construction boom, which could itself drive the reallocation we document. We restrict the sample to episodes with a large construction run-up and compare those followed by a crisis with those that are not. Figure A.24 shows that the reallocation patterns remain broadly similar to those in our baseline analysis.

# 4 Model of Structural Transformation with Distortions

In this section, we develop a multi-sector open-economy model. In addition to the standard income and price effects emphasized in the structural change literature (Herrendorf *et al.*, 2014; Comin *et al.*, 2021), the model allows changes in international trade and demand- and supply-side distortions to drive sectoral reallocation. We begin by describing the model and defining its competitive equilibrium, and conclude the section with a discussion of the relationship between the wedges and crises.

We use the model for two purposes. First, in Section 5, we use it as a measurement device to decompose the sectoral reallocation documented in Section 3 into its underlying drivers. Second, in Section 6, we solve for the model's transitional dynamics

and match both the long-run patterns of structural transformation and the dynamics observed around crises to quantify how much a crisis changes the pace of structural transformation.

## 4.1 Setup

The model is a discrete-time general equilibrium framework for a small open economy with multiple sectors. There are two countries: Home and Foreign (the rest of the world, denoted by $*$). Home households have non-homothetic CES preferences over a finite set of sectors $\mathcal{I}$. Within each sector, they allocate expenditures between home and foreign varieties. Firms operate constant returns to scale technologies with sector-specific productivity growth and capital intensities. Sector-level distortions affect firms' and households' decisions and trade. Appendix B.1 provides details on the model derivation.

**Wedges.** In the spirit of the business-cycle accounting literature (Chari *et al.*, 2007), we introduce sector-level wedges that distort households' and firms' decisions, potentially varying over time. Distortions on consumption expenditures are $\tau^c_{it}$; on firms' capital and labor choices, $\{\tau^k_{it}, \tau^w_{it}\}$; and on deviations from the law of one price, $\{\tau^H_{it}, \tau^F_{it}\}$. Each wedge equals one in the absence of distortions, and we refer to the wedges and the distortions they represent interchangeably. We take them as exogenous here and recover them from observables in Section 5.1. We discuss the economic interpretation of these distortions at the end of this section. While we assume that, in the transition, these distortions fade out in the long run, they may change in response to crisis shocks, which we define in Section 6.

**Households.** A representative domestic household has preferences over consumption:

$$\sum_{t\geq 0} \beta^t \frac{c_t^{1-\theta} - 1}{1-\theta}, \tag{4}$$

where $\beta \in (0,1)$ is the subjective discount factor and $\theta$ determines the intertemporal elasticity of substitution. The household aggregates consumption implicitly by:

$$c_t = \left[ \sum_{i \in \mathcal{I}} \gamma_{it}^{\frac{1}{\sigma}} \left( \frac{c_{it}}{c_t^{\varepsilon_i - 1}} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \tag{5}$$

where $c_{it}$ is the consumption of sector $i \in \mathcal{I}$ at time $t$, $\varepsilon_i$ is the income elasticity for sector $i$, $\sigma$ determines the substitution across sectors, and $\gamma_{it}$ is a time-varying demand shifter that captures changes in demand unexplained by prices and income.[15] Moreover, within each sector $i \in \mathcal{I}$, the household aggregates home and foreign varieties of $c_{it}$ using a CES aggregator (Armington, 1969):

$$c_{it} = \left[ (1-\phi_i)^{\frac{1}{\nu_i}} c_{Hit}^{\frac{\nu_i - 1}{\nu_i}} + \phi_i^{\frac{1}{\nu_i}} c_{Fit}^{\frac{\nu_i - 1}{\nu_i}} \right]^{\frac{\nu_i}{\nu_i - 1}}, \tag{6}$$

where $\nu_i$ is the elasticity of substitution between varieties and $\phi_i$ is the sector-level trade openness parameter, reflecting a mix of home bias in preferences, trade costs, and non-tradable goods (Obstfeld and Rogoff, 2001). This implies that the sector-level consumer price index is $p_{cit} = \left[ (1-\phi_i)\, p_{Hit}^{1-\nu_i} + \phi_i\, p_{Fit}^{1-\nu_i} \right]^{\frac{1}{1-\nu_i}}$, where $p_{Hit}$ and $p_{Fit}$ denote the domestic prices of the home and foreign varieties of sector $i$, respectively.

Aside from choosing consumption, households decide investment $x_t$ each period. They rent capital $K_t$ to firms at rate $R_t$, starting from an initial endowment $K_0$. Capital accumulates according to:

$$K_{t+1} = (1-\delta) K_t + x_t, \tag{7}$$

with $\delta \in (0,1)$ the constant capital depreciation rate. Households can also save in a risk-free foreign asset $a_t$ that pays return $r_t$ in foreign currency. They supply one unit of labor inelastically at wage $w_t$,[16] own all domestic firms, and receive a lump-sum transfer $T_t$ that rebates the distortions on consumption, input choices and trade. The

[15] Section 5.1 discusses an extension with Stone-Geary preferences, derived in Appendix B.7.

[16] Section 5.1 discusses an extension with imperfect labor mobility across sectors, derived in Appendix B.10.

budget constraint is:

$$\sum_{i\in\mathcal{I}} \tau^c_{it} p_{cit} c_{it} + p_{xt} x_t + e_t a_{t+1} \;\leq\; w_t + R_t K_t + e_t a_t (1 + r_t) + \sum_{i\in\mathcal{I}\cup\{0\}} \pi_{it} + T_t, \tag{8}$$

where $e_t$ is the exchange rate. We consider a debt-elastic country interest rate, $r_t = r^* - \psi\left(a_t / A_{0t}^{1/(1-\alpha_0)} - \bar{a}\right)$ with $\psi > 0$, following Schmitt-Grohé and Uribe (2003), which pins down the otherwise indeterminate long-run net foreign asset position at the target $\bar{a}$.[17] Firms' profits are zero in equilibrium because their technology has constant returns to scale.

The household's problem can be decomposed into two subproblems: (i) the intertemporal choice between aggregate consumption and savings; and, given total expenditure in that period, (ii) the intratemporal allocation of consumption across sectors.

Between periods, households choose consumption $c_t$, asset holdings $a_{t+1}$, and capital investment $x_t$ to maximize utility (4) subject to the budget constraint (8). The Euler equation states that the marginal utility of consuming one unit today equals the discounted value of investing it, renting out the resulting capital next period, and consuming the payoff:

$$c_t^{-\theta} = \beta\, c_{t+1}^{-\theta} \frac{p_{xt+1}}{p_{ct+1}} \frac{p_{ct}}{p_{xt}} \frac{\bar{\varepsilon}_t}{\bar{\varepsilon}_{t+1}} \left( \frac{R_{t+1}}{p_{xt+1}} + 1 - \delta \right). \tag{9}$$

To derive equation (9), we note that total consumption expenditure is given by $E_t \equiv \sum_{i\in\mathcal{I}} \tau^c_{it}\, p_{cit}\, c_{it}$, and we define the expenditure-weighted aggregate income elasticity as $\bar{\varepsilon}_t \equiv \sum_{i\in\mathcal{I}} \varepsilon_i \frac{\tau^c_{it} p_{cit} c_{it}}{E_t}$. The consumption price index is given by $p_{ct} \equiv E_t / c_t$, which includes the consumption wedges, unlike the sectoral indexes $p_{cit}$, and we normalize the investment price to one in every period, $p_{xt} \equiv 1\ \forall t$. Finally, no-arbitrage in asset markets implies $(1 + r_{t+1}) \frac{e_{t+1}}{e_t} = \left( \frac{R_{t+1}}{p_{xt+1}} + 1 - \delta \right) \frac{p_{xt+1}}{p_{xt}}$.

Within a period, households choose consumption in each sector $i$ in order to minimize total consumption expenditures subject to consumption aggregator, resulting in demands across $i$:

$$c_{it} = \gamma_{it} \left( \frac{\tau^c_{it} p_{cit}}{E_t} \right)^{-\sigma} c_t^{\varepsilon_i (1-\sigma)}, \tag{10}$$

[17] At a constant world rate the household is indifferent about how much to hold abroad, so any temporary trade imbalance permanently shifts net foreign assets and the economy could settle at any long-run level. Tying the rate to debt removes this indifference: a country that borrows more faces a higher rate and is drawn back toward $\bar{a}$.

with expenditure function $E_t(c_t, \mathbf{p}_t, \boldsymbol{\tau}_t) = \left[\sum_{i\in\mathcal{I}} \gamma_{it}\left(\tau^c_{it} p_{cit}\right)^{1-\sigma} c_t^{\varepsilon_i(1-\sigma)}\right]^{\frac{1}{1-\sigma}}$.

Finally, within each sector, the demand for home and foreign varieties are:

$$c_{Hit} = (1-\phi_i)\left(\frac{p_{Hit}}{p_{cit}}\right)^{-\nu_i} c_{it} \quad \text{and} \quad c_{Fit} = \phi_i\left(\frac{p_{Fit}}{p_{cit}}\right)^{-\nu_i} c_{it}. \tag{11}$$

**Firms.** Home firms are homogeneous within each sector. There are production sectors $i \in \mathcal{I}$ and an investment sector $i = 0$. Firms in all sectors operate a Cobb–Douglas technology that combines labor $L_{it}$ and capital $K_{it}$:

$$Y_{it} = A_{it} K_{it}^{\alpha_i} L_{it}^{1-\alpha_i},$$

where $A_{it}$ denotes sectoral productivity and $\alpha_i \in (0,1)$ is the capital share. The investment sector satisfies $Y_{0t} = x_t$, and its output is sold at the investment price, $p_{H0t} = p_{xt}$, which serves as the numeraire. Firms take prices as given and choose inputs to maximize profits:

$$\pi_{it} = \max_{L_{it}, K_{it}} \; p_{Hit} Y_{it} - \tau^w_{it} w_t L_{it} - \tau^k_{it} R_t K_{it}, \tag{12}$$

where $\tau^w_{it}$ and $\tau^k_{it}$ are sector-specific wedges on labor and capital, following Hsieh and Klenow (2009).[18] We take the investment sector's input choices to be undistorted, $\tau^w_{0t} = \tau^k_{0t} = 1$.[19] The firms' first-order conditions for $i \in \mathcal{I} \cup \{0\}$ imply:

$$(1-\alpha_i) p_{Hit} Y_{it} = \tau^w_{it} w_t L_{it}, \tag{13}$$

$$\alpha_i p_{Hit} Y_{it} = \tau^k_{it} R_t K_{it}. \tag{14}$$

We assume sectors $i \in \mathcal{I}$ produce for both domestic and foreign demand, while the investment sector's output cannot be exported.

**Foreign demand.** Because the economy is small and open, we take foreign demand for home varieties as given,

$$c^*_{Hit} = c^*_{Hit}(p^*_{Hit}, \xi^*_{it}), \qquad i \in \mathcal{I}, \tag{15}$$

[18] Section 5.1 discusses extensions with input–output linkages and with CES aggregation of capital and labor, derived in Appendix B.8 and Appendix B.9.

[19] To reproduce the observed long-run changes in $K/Y$, Section 6 reintroduces a capital wedge in the investment sector when we solve the transition.

with each demand decreasing in its own price and increasing in exogenous, time-varying demand shifters.

**Trade distortions.** We assume also that the law of one price may not hold, such that the prices for home and foreign varieties of $i \in \mathcal{I}$ are

$$\tau_{it}^{H} p_{Hit} = e_t p_{Hit}^{*} \tag{16}$$

$$p_{Fit} = \tau_{it}^{F} e_t p_{Fit}^{*}, \tag{17}$$

where $e_t$ is the exchange rate and $\{\tau_{it}^{H}, \tau_{it}^{F}\}_{i \in \mathcal{I}}$ are sector-level deviations from the law of one price (e.g., trade costs). Foreign prices $\{p_{Fit}^{*}\}_{i \in \mathcal{I}}$ are exogenous.

**Market clearing and trade balance.** Labor and capital market clearing imply $1 = \sum_{i \in \mathcal{I} \cup \{0\}} L_{it}$ and $K_t = \sum_{i \in \mathcal{I} \cup \{0\}} K_{it}$. Sectoral market clearing for $i \in \mathcal{I}$ equates the domestic production of good $i$ with its home and foreign absorption, while output in sector 0 is used as investment:

$$Y_{it} = c_{Hit} + c_{Hit}^{*} \qquad \text{for } i \in \mathcal{I} \tag{18}$$

$$Y_{0t} = x_t. \tag{19}$$

Moreover, we assume that distortions are rebated to the household, so that the government budget constraint holds

$$\begin{aligned} T_t = \sum_{i \in \mathcal{I}} [ & (\tau_{it}^{c} - 1)\, p_{cit} c_{it} + (\tau_{it}^{w} - 1)\, w_t L_{it} + \left(\tau_{it}^{k} - 1\right) R_t K_{it} \\ & + \left(\tau_{it}^{F} - 1\right) e_t p_{Fit}^{*} c_{Fit} + \frac{(\tau_{it}^{H} - 1)}{\tau_{it}^{H}} e_t p_{Hit}^{*} c_{Hit}^{*} ]. \end{aligned} \tag{20}$$

Finally, we obtain the home country budget constraint combining the household budget constraint (8) with firms' profits (12) and the market clearing conditions:

$$(a_{t+1} - a_t\,(1 + r_t)) = \sum_{i \in \mathcal{I}} \left(p_{Hit}^{*} c_{Hit}^{*} - p_{Fit}^{*} c_{Fit}\right) \equiv NX_t \tag{21}$$

where $NX_t$ denotes aggregate net exports in units of foreign currency. The home budget constraint together with the Euler equation determine a condition on the path of consumption and the nominal exchange rate.

## 4.2 Competitive Equilibrium

Given initial capital $K_0$ and foreign assets $a_0$, demand shifters $\{\gamma_{it}, \xi^*_{it}\}_{i\in\mathcal{I},t\geq 0}$, sectoral productivities $\{A_{it}\}_{i\in\mathcal{I}\cup\{0\},t\geq 0}$, sectoral distortions $\{\tau^c_{it}, \tau^w_{it}, \tau^k_{it}, \tau^H_{it}, \tau^F_{it}\}_{i\in\mathcal{I},t\geq 0}$, foreign prices $\{p^*_{Fit}\}_{i\in\mathcal{I},t\geq 0}$, and foreign demand schedules $\{c^*_{Hit}(\cdot)\}_{i\in\mathcal{I},t\geq 0}$, a *competitive equilibrium* is a sequence of capital and assets $\{K_{t+1}, a_{t+1}\}_{t\geq 0}$, firm input choices $\{L_{it}, K_{it}\}_{i\in\mathcal{I}\cup\{0\},t\geq 0}$, household consumption and investment $\{c_t, x_t, (c_{it}, c_{Hit}, c_{Fit})_{i\in\mathcal{I}}\}_{t\geq 0}$, exports $\{c^*_{Hit}\}_{i\in\mathcal{I},t\geq 0}$, equilibrium prices $\{w_t, R_t, e_t, p_{ct}, (p_{cit}, p_{Hit}, p_{Fit}, p^*_{Hit})_{i\in\mathcal{I}}\}_{t\geq 0}$, an interest rate $\{r_t\}_{t\geq 0}$, and transfers $\{T_t\}_{t\geq 0}$ such that: (i) households maximize utility subject to their budget constraint (8); (ii) firms maximize profits (12); (iii) exports satisfy foreign demand (15) and traded-goods prices satisfy (16)–(17); (iv) the labor and capital markets clear, and the goods markets clear (18)–(19); (v) the interest rate follows the debt-elastic rule and the exchange rate satisfies the no-arbitrage condition between domestic capital and foreign assets; (vi) the government budget constraint (20) holds; and (vii) net foreign assets evolve according to the country budget constraint, with $\lim_{t\to\infty} a_{t+1}\prod_{s\leq t}(1+r_s)^{-1} = 0$.

## 4.3 Discussion

**Distortions and Financial Frictions.** The formulation of distortions is broad and builds on the business cycle accounting literature (Chari *et al.*, 2007). Although we do not explicitly model financial frictions, the wedges in our model can capture the effects of a contraction in credit during a financial crisis. For instance, if firms borrow against collateral to finance capital, a tightening of the collateral constraint can manifest as an increase in the capital wedge $\tau^k_{it}$. If instead firms borrow to finance their wage bill before receiving revenue, an increase in borrowing costs can manifest as an increase in the labor wedge $\tau^w_{it}$ (Neumeyer and Perri, 2005). Furthermore, a given friction need not map into a single wedge. For example, Buera and Moll (2015) show that a credit crunch can manifest in different wedges, including the investment and labor wedges. On the household side, restrictions on credit access can manifest as an increase in the consumption wedge $\tau^c_{it}$, while constraints on financing imported goods can increase the trade wedge $\tau^F_{it}$ (Mendoza, 2010).

The wedges can also move for reasons other than credit, as crises are often followed by significant policy changes (Rodrik, 1996). For example, trade policy often shifts in

the aftermath of a crisis, which can affect the trade wedge (see the post-crisis trade liberalization episodes in Section 3.3). Similarly, Cole and Ohanian (2004) show that labor market policies account for a persistent labor wedge following the Great Depression.

**Long-Run and Medium-Run Dynamics.** Models of structural transformation are designed to explain gradual sectoral reallocation driven by changes in income and relative prices, while the wedges we introduce capture higher-frequency fluctuations. We reconcile these two forces by assuming that the wedges vanish asymptotically along the transition, as required by Proposition 2, while sectoral productivities and foreign demand shifters can experience permanent level shifts. Thus, crises can have persistent effects on structural transformation through changes in fundamentals, while the wedges capture the medium-run dynamics without affecting the long-run properties of the model. Our key identifying assumption is that the income and price elasticities estimated in the structural transformation literature from variation across levels of development also govern the response to crises.

# 5 Drivers of Post-Crisis Sectoral Reallocation

In this section, we use the model to quantify the forces driving the sectoral reallocation documented in Section 3. We first present the decomposition and explain how we measure each channel, and then assess their quantitative importance.

## 5.1 Decomposition

In a competitive equilibrium, the change in relative employment across sectors $i$ and $j$ decomposes into income effects, price effects, trade reallocation, and distortions to labor and demand:

$$\begin{aligned}\Delta \log\left(\frac{L_{it}}{L_{jt}}\right) = & \underbrace{\left(\varepsilon_i - \varepsilon_j\right)(1-\sigma)\,\Delta \log c_t}_{\text{income effect}} + \underbrace{(1-\sigma)\,\Delta \log\left(\frac{p_{cit}}{p_{cjt}}\right)}_{\text{price effect}} \\ & + \underbrace{\Delta \log\left(\frac{p_{Hit}Y_{it}/p_{cit}c_{it}}{p_{Hjt}Y_{jt}/p_{cjt}c_{jt}}\right)}_{\text{trade reallocation}} - \underbrace{\Delta \log \Omega^{L}_{ijt}}_{\text{L distortions}} - \underbrace{\Delta \log \Omega^{D}_{ijt}}_{\text{D distortions}} \end{aligned} \tag{22}$$

where $\Omega^L_{ijt} \equiv \tau^w_{it}/\tau^w_{jt}$ and $\Omega^D_{ijt} \equiv \frac{\gamma_{jt}}{\gamma_{it}}\left(\frac{\tau^c_{jt}}{\tau^c_{it}}\right)^{-\sigma}$. We obtain it by combining the firms' labor first order condition with the demand system (10) and each sector's resource constraint (18). Proposition 1 in Appendix B.1 states it formally and derives it.

The decomposition holds between any two sectors. Throughout, we take $j$ to be manufacturing, so all changes in employment are measured relative to manufacturing. As is standard in the structural transformation literature, we assume $\sigma < 1$. The income effect, $\left(\varepsilon_i - \varepsilon_j\right)(1-\sigma)\,\Delta \log c_t$, follows from non-homothetic preferences, under which the distribution of expenditure across sectors depends on the level of consumption. A crisis reduces aggregate consumption, shifting demand toward sectors with lower income elasticities, such as agriculture. The price effect, $(1-\sigma)\,\Delta \log\left(p_{cit}/p_{cjt}\right)$, works in the opposite direction to the usual substitution intuition. Since $\sigma < 1$, sectors are complements, so a decline in a sector's relative price reduces its employment relative to manufacturing rather than increasing it (Ngai and Pissarides, 2007).

The trade term compares what a sector produces with what is consumed at home, so a sector whose net exports rise relative to another gains employment beyond what domestic demand would imply. Labor distortions $\Omega^L_{ijt}$ raise the effective cost of labor in one sector relative to another, so a sector supports a given value added with less employment, which is why we read them off the gap between value added and employment dynamics. Demand distortions $\Omega^D_{ijt}$ collect movements in expenditure that the demand system does not explain.

The decomposition is an accounting identity that holds in any competitive equilibrium and that we evaluate at the observed paths, so each channel is measured taking the others as given rather than as an independent shock.

### 5.1.1 Alternative Channels

We consider four variants to the baseline model, each detailed in the appendix. First, Stone-Geary preferences introduce subsistence consumption, an additional source of non-homotheticity (Herrendorf *et al.*, 2014). Under that demand system a contraction in consumption would reallocate activity toward agriculture more strongly in poorer economies (Appendix B.7), while we find in the data that the reallocation increases with income at the onset of the crisis (Figure A.11). Matching this fact would likely increase the role of wedges. Second, production linkages leave the decomposition

unchanged but affect how the price effect maps into underlying fundamentals (Appendix B.8). Moreover, we find that value added and gross output exhibit similar reallocation patterns in the data (Figure A.30), suggesting that the relative importance of production linkages across sectors changes little during crises. Third, if capital and labor are imperfect substitutes, part of the labor distortion we measure may reflect a capital distortion, though this reading requires the relative cost of capital to remain elevated a decade after the crisis (Appendix B.9). Finally, imperfect labor mobility across sectors implies that employment reallocates less than value added, whereas between agriculture and manufacturing we find the opposite (Appendix B.10).

### 5.1.2 Inference

Some components of the decomposition are directly observed in the data: relative employment $L_{it}/L_{jt}$, aggregate consumption $c_t$, and the ratio of nominal value added to consumption expenditures that enters the trade channel.[20] The remaining components are not directly observed, but the equilibrium conditions of the model allow us to express each of them as a function of observables and parameters alone. Relative consumption prices follow from relative output prices and the domestic consumption share of each sector. We identify labor distortions from the gap between value-added and employment dynamics. For example, if a sector's nominal output relative to a base sector (manufacturing in our application) grows faster than its relative employment, its labor wedge increases relative to the base sector. Finally, we recover demand distortions as the residual between observed relative consumption expenditures and what the demand system predicts given relative prices and aggregate consumption. Appendix B.2 provides the details of these derivations.

## 5.2 Quantification

To quantify the drivers of post-crisis sectoral labor reallocation, we isolate each channel in (22) and use the resulting simulated data to estimate the event-study specification

[20] We use aggregate real expenditure from national accounts to measure aggregate real consumption. This can be interpreted as a restriction on the common component of the consumption wedge: writing $\tau^c_{it} = \hat{\tau}^c_{it}\tau^c_t$, the restriction $(\tau^c_t)^{-1} = \sum_{i\in\mathcal{I}} \gamma_{it} \left[\hat{\tau}^c_{it} p_{cit}\right]^{1-\sigma} c_t^{\varepsilon_i(1-\sigma)-1}$ ensures that $c_t = E_t$. Comin *et al.* (2021) instead use base-sector prices and total nominal expenditure, which aligns more closely with the theory but raises concerns when nominal expenditure and prices come from different sources, particularly during crises characterized by high inflation and large relative price changes.

in equation (2). We evaluate each term at its measured value while holding the others at theirs, which gives the contribution of each channel to the observed reallocation.

**Parameters.** To simulate labor shares using the decomposition in (22), we need values for the substitution parameter $\sigma$, the income elasticities $\{\varepsilon_i\}_{i\in\mathcal{I}}$, and the trade elasticity $\nu$, which we assume is common across sectors. We calibrate them externally from Comin *et al.* (2021) and Simonovska and Waugh (2014), with $\sigma = 0.5$, and report the values in Appendix B.3. Income elasticities are measured relative to manufacturing: agriculture is well below one, so its demand falls relative to manufacturing as aggregate consumption rises, while services is above one.

**Samples.** The trade channel requires sectoral trade data, which we observe for the WIOD sample of 39 countries and 41 crisis episodes. We therefore report the decomposition twice. In the WIOD sample all channels are separated, while in the whole sample of 102 episodes sectoral trade is not measured and its role is absorbed into the distortions.[21]

**Results.** Table 3 reports the contribution of each channel, averaged over the eighth to eleventh year after the onset of the crisis, for both samples. Appendix A.4 shows the full dynamics behind them.

The income and price effects of the standard structural transformation model account for little of the reallocation. For agriculture the two work against each other. The contraction in aggregate consumption raises relative employment through the income effect by about 4%, while the fall in the relative price of agriculture pushes it back by about 2%, since sectors are complements and a fall in a sector's relative price reduces rather than raises its employment. Together they deliver about 2%, against a measured rise of about 12%. For the whole sample, we observe the same: the sum of both channels is close to 0, while the observed reallocation to agriculture is greater than 6%. For services, both effects are negative, totaling about 4%, while the observed decline is smaller and close to zero. In the full sample, the combined effect also overpredicts the relative decline in services, although to a lesser extent.

The decade averages also hide important dynamics. The price effect for agriculture

[21] As described in Section 2.1, WITS data would extend trade coverage to the whole sample. However, its measurement is inconsistent, thus we omit it.

**Table 3:** Contributions to Post-Crisis Reallocation

| | (a) WIOD sample | | (b) Whole sample | |
|---|---|---|---|---|
| | Agriculture | Services | Agriculture | Services |
| Data, $\Delta \log (L_i / L_{\text{MAN}})$ | +11.9 | −0.5 | +6.4 | −1.7 |
| Income effect | +4.2 | −1.0 | +3.5 | −0.8 |
| Price effect | −2.2 | −3.3 | −3.2 | −1.9 |
| Trade reallocation | +1.8 | −8.1 | — | — |
| Labor distortions | +5.0 | +1.9 | +6.7 | +6.5 |
| Demand distortions | +1.8 | +12.8 | +0.9 | −3.6 |

*Notes*: Contribution of each channel to the change in employment relative to manufacturing, in percent, averaged over years +8 to +11 after the onset of the crisis. Panel (a) uses the WIOD sample, where sectoral trade is observed; Panel (b) the whole sample, where it is not and the trade channel is absorbed into the distortions. The decomposition holds observation by observation, so the channels add up exactly in the underlying series. The estimated responses do not, by at most about three percentage points in any column, because the event-study specification includes lagged dependent variables whose coefficients are estimated separately for each channel.

reaches almost −7% in the second year before unwinding, while relative employment in services rises by about 3% over the first three years before returning to roughly zero (see Appendix A.4 ).

The two panels differ in which episodes they cover and in whether trade is measured. The WIOD data cover 23 of the 24 crisis episodes in developed economies but only 18 of the 78 in emerging ones, which is why the measured rise in agriculture is about 12% in Panel (a) and about 6% in Panel (b), in line with the income gradient of Section 3.3. Beyond that difference in composition the two samples are similar (Appendix A.3).

Trade pulls the two sectors apart.[22] Net exports in agriculture rise relative to manufacturing and add about 2%, whereas in services the rise in manufacturing net exports with little change in services trade subtracts about 8%. Measuring trade also changes what the wedges are left to explain. With trade separated, the demand distortion for services is about 13% and the labor wedge about 2%. In the whole sample, where trade is folded into the wedges, the labor wedge for services rises to about 7% and the demand distortion turns to about −4%.

What survives in both panels is the persistence of the distortions. The labor wedge reallocates employment out of manufacturing toward both sectors, by about 5% and

[22] In Appendix A.1 we document the reallocation of sectoral net exports and domestic absorption behind this channel.

7% for agriculture in the two samples, and does not fade over the decade. This is consistent with Chari *et al.* (2007), who find a significant role for aggregate labor wedges in the Great Depression and the 1982 U.S. recession, and with Cole and Ohanian (2004), who documents large labor distortions in manufacturing during the Great Depression. Our results extend this evidence to reallocation across sectors, as a common feature of crises across countries. Because we measure these wedges rather than fit them, we can carry them into the equilibrium transition of Section 6 and ask about their role once the rest of the economy adjusts.

## 5.3 Additional Results

We next report the decomposition separately by level of development, by type of crisis, and within services. Both use the whole sample, so there is no trade channel and the magnitudes compare to Panel (b) of Table 3. The tables are in Appendix A.5.

**Emerging and Developed Economies.** Table A.5 splits the sample by level of development. The reallocation is far larger in developed economies, where relative employment in agriculture rises by about 18% against about 2% in emerging ones, consistent with the income gradient in Section 3.3. The forces behind it also differ. In emerging economies the labor wedge supplies the largest contribution in both sectors, about 7% for agriculture and 9% for services, and demand distortions work against it. In developed economies the labor wedge is smaller and demand distortions do more of the work, contributing about 9% for agriculture. The income effect is also about twice as large in developed economies which, since the elasticities are common across samples, reflects a deeper contraction in aggregate consumption.

**Types of Crisis.** Table A.6 repeats it for banking crises, sovereign debt crises, crises with large devaluations, and crises with large growth reversals. The pattern is stable across the first, third and fourth: income raises relative employment in agriculture, prices push it back, and the labor wedge supplies the largest contribution. Sovereign debt crises are the exception. There the labor wedge moves against agriculture rather than toward it, and the demand distortion for services turns sharply negative, which is the reallocation from non-tradable to tradable activity documented for these episodes (Kehoe and Ruhl, 2009; Arellano *et al.*, 2018). The measured reallocation itself is also

different: relative employment in agriculture falls rather than rises, and in services it falls by about 9%.

**Service Sectors.** Table A.7 reports the decomposition for the four narrower service sectors, using the income elasticities estimated by Comin *et al.* (2021).[23] In all four the income and price effects together predict a larger decline than we measure, and the labor wedge offsets the difference, moving employment into each sector by between about 2% and 6% relative to manufacturing. Wholesale and retail trade is the clearest case, where the two effects push employment down by more than 3% while the measured change is slightly positive. Finance and real estate records the largest decline in the data, about 5%, and also the largest income effect, since its income elasticity is the highest of the four. Demand distortions stay small throughout, between about $-2\%$ and $+2\%$.

# 6 Long-Run Impact of Crises on the Economic Structure

The decomposition of the previous section takes each channel at its measured value. Relative prices, aggregate consumption, and sectoral net exports are equilibrium objects rather than primitives, however, so the accounting delivers the contribution of each channel without taking into account the equilibrium effects of changes in the fundamentals that explain them.

To account for these equilibrium effects, in this section we quantify the long-run impact of crises on the path of development. We calibrate the economy so that its baseline transition reproduces the cross-country patterns of structural transformation in Section 2.2, and we model a crisis as an unexpected (MIT) shock to fundamentals, disciplined by the post-crisis dynamics in Section 3, with the distortions held at the paths recovered from the accounting exercise in Section 5. The shock moves fundamentals onto a new path that still converges to the same constant growth path, so a crisis changes when an economy reaches a given structure rather than where it ends up. We then ask how the same shock affects economies at different stages of development, why the answer depends on the stage, and how many years of structural

[23] The values are $\varepsilon_{\text{WRT}} = 1.62$ for wholesale and retail, $\varepsilon_{\text{TRA}} = 1.44$ for transport, storage and communications, $\varepsilon_{\text{FIRE}} = 2.17$ for finance, insurance and real estate, and $\varepsilon_{\text{OTH}} = 1.18$ for personal and other services.

transformation a crisis costs. We first characterize the long-run constant growth path and then the transition dynamics.

## 6.1 Long-Run and Transitional Dynamics

Solving the transition requires knowing where the economy ends up. We characterize the long-run constant growth path first, and then the dynamics that take the economy there from an arbitrary initial capital stock and net foreign asset position.

### 6.1.1 Constant Growth Path

**Proposition 2** (Constant Growth Path)**.** *Consider an economy where utility follows* (4) *and sectoral productivities grow at heterogeneous but constant rates,* $A_{it+1}/A_{it} = 1 + g_i$ *for* $i \in \mathcal{I} \cup \{0\}$*. Assume that capital intensity is common across sectors,* $\alpha_i = \alpha$*, and that the nominal exchange rate is asymptotically constant,* $\lim_{t\to\infty} e_{t+1}/e_t = 1$*, with the exogenous world interest rate given by* $\beta(1+r^*) = (1+g_0)^{\frac{1}{1-\alpha}}(1+g^*)^{\theta-1}$*. Assume further that sectoral foreign prices grow asymptotically at* $\lim_{t\to\infty} p^*_{Fit+1}/p^*_{Fit} = (1+g_0)/(1+g_i)$ *for all* $i \in \mathcal{I}$*, that all distortions vanish in the long run,* $\lim_{t\to\infty} \tau^x_{it} = 1$ *for* $i \in \mathcal{I}$ *and* $x \in \{c, w, k, H, F\}$*, as well as* $\lim_{t\to\infty} \tau^k_{0t} = 1$*, that the demand shifters are constant in the long run,* $\lim_{t\to\infty} \gamma_{it} = \gamma_i$ *for* $i \in \mathcal{I}$*, and that the country interest rate is debt-elastic,* $r_t = r^* - \psi\left(a_t/A_{0t}^{1/(1-\alpha)} - \bar{a}\right)$ *with* $\psi > 0$ *and* $\bar{a} = 0$*, so that net foreign assets and net exports are asymptotically zero. Then the economy has a* constant growth path *(CGP) along which real per-capita consumption grows at the constant rate* $g^*$*,*

$$1 + g^* = \min_{i\in\mathcal{I}} \left[(1+g_0)^{\frac{\alpha}{1-\alpha}}(1+g_i)\right]^{\frac{1}{\varepsilon_i}} \qquad (\text{for } \sigma < 1),$$

*and only the sector(s) attaining the minimum retain a non-negligible expenditure share in the long run. Along this path, consumption expenditure, investment, and the capital stock all grow at the rate dictated by the productivity growth of the investment sector,* $(1+g_0)^{1/(1-\alpha)}$*, and each sector's share of consumption expenditure grows at a constant rate, and the capital–labor ratio is given by* $\kappa^* = \left(\frac{\alpha}{r^*+\delta}\right)^{\frac{1}{1-\alpha}}$*.*

Appendix B.4 provides the proof. In our calibration the transition converges to this path, which we verify numerically. The constant growth path coincides with that of the closed economy in Comin *et al.* (2021), with trade and the exchange rate shaping

only the transition.[24] As the economy grows, the sector that combines low productivity growth with a high income elasticity — the one with the lowest $(1+g_i)^{1/\varepsilon_i}$ — comes to dominate. In this case that sector is services, and its share of total expenditure converges to one. A useful feature of this path is that it depends on the growth rates of productivity and on the income elasticities, not on their levels. A permanent change in the level of a fundamental, such as the drop in productivity a crisis leaves behind, therefore leaves $g^*$, the surviving sector and the capital-labor ratio unchanged. The economy converges to the same asymptotic path, and what a crisis changes is how long it takes to get there.

### 6.1.2 Transitional Dynamics

To characterize the dynamics away from the CGP, we detrend each aggregate by its constant growth-path trend. For a variable $X_t$ growing at the investment-sector rate we write $\tilde{X}_t \equiv X_t / A_{0t}^{1/(1-\alpha)}$ — detrended capital $\tilde{k}_t$, expenditure $\tilde{E}_t$, net foreign assets $\tilde{a}_t$, and net exports $\widetilde{NX}_t$ — and detrend the real consumption index by $\tilde{c}_t \equiv c_t/(1+g^*)^t$. By construction every tilde variable is constant on the CGP of Proposition 2.

Outside the CGP the economy follows a perfect-foresight transition, described by a system in detrended consumption $\tilde{c}_t$ and the nominal exchange rate $e_t$, given two predetermined states, detrended capital $\tilde{k}_t$ and net foreign assets $\tilde{a}_t$. These are determined each period by capital accumulation, the balance of payments, the consumption Euler equation, and no-arbitrage between domestic capital and the foreign bond:

$$\tilde{k}_{t+1}(1+g_{0t+1})^{\frac{1}{1-\alpha}} = (1-\delta)\,\tilde{k}_t + \tilde{k}_{0t}^{\alpha} - \Xi_t, \tag{23}$$

$$\tilde{a}_{t+1}(1+g_{0t+1})^{\frac{1}{1-\alpha}} = (1+r_t)\,\tilde{a}_t + \widetilde{NX}_t, \tag{24}$$

$$\left(\frac{\tilde{c}_{t+1}}{\tilde{c}_t}(1+g^*)\right)^{\theta-1}\frac{\tilde{E}_{t+1}}{\tilde{E}_t}(1+g_{0t+1})^{\frac{1}{1-\alpha}}\frac{\bar{\varepsilon}_{t+1}}{\bar{\varepsilon}_t} = \beta\,(1+r_{t+1})\,\frac{e_{t+1}}{e_t}, \tag{25}$$

$$(1+r_{t+1})\,\frac{e_{t+1}}{e_t} = \frac{\alpha}{\tau^k_{0t+1}}\,\tilde{k}_{0t+1}^{\alpha-1} + 1 - \delta, \tag{26}$$

where $\tilde{k}_{0t} \equiv \tilde{K}_{0t}/L_{0t}$ is the detrended capital-labor ratio in the investment sector. With wedges, capital-labor ratios differ across sectors. Combining the firms' first order con-

[24] With $\sigma > 1$ the min is replaced by a max. Opening the economy leaves the structural-change block — the growth rates of the expenditure shares, the consumption growth rate $g^*$, and the surviving sectors — invariant, provided the nominal exchange rate is asymptotically constant and foreign prices grow at the CGP-consistent rates; the exchange rate and trade enter only the nominal block and the transition.

ditions, $R_t/w_t = \frac{\alpha}{1-\alpha}\frac{\tau^w_{it}}{\tau^k_{it}}\frac{L_{it}}{K_{it}}$, the ratio in sector $i$ is $\tilde{k}_{it} = \frac{\tau^w_{it}\tau^k_{0t}}{\tau^k_{it}}\tilde{k}_{0t}$, and since aggregate capital is $\tilde{k}_t = \sum_{i\in\mathcal{I}}\tilde{k}_{it}L_{it} + \tilde{k}_{0t}L_{0t}$, the investment-sector ratio is tied to aggregate capital by

$$\tilde{k}_{0t} = \left[\sum_{i\in\mathcal{I}}\frac{\tau^w_{it}\tau^k_{0t}}{\tau^k_{it}}L_{it} + L_{0t}\right]^{-1}\tilde{k}_t. \tag{27}$$

When distortions vanish all sectors share the same ratio and $\tilde{k}_{0t} = \tilde{k}_t$, as on the CGP. Output of the investment sector is $\tilde{k}^{\alpha}_{0t}L_{0t}$, and labor market clearing gives $1 - L_{0t} = \tilde{k}^{-\alpha}_{0t}\,\Xi_t$, which is how absorption $\Xi_t$ enters (23). Detrended *absorption*,

$$\Xi_t \equiv \sum_{i\in\mathcal{I}}\frac{1}{\tau^w_{it}}\left[\frac{\omega_{it}\tilde{E}_t}{\tau^c_{it}} + \widetilde{nx}^d_{it}\right],$$

is the wage-wedge-weighted value of each sector's domestic consumption, $\omega_{it}\tilde{E}_t/\tau^c_{it} = p_{cit}c_{it}/A^{1/(1-\alpha)}_{0t}$, plus its net exports valued at domestic prices, $\widetilde{nx}^d_{it} \equiv \left(p_{Hit}c^*_{Hit} - p_{Fit}c_{Fit}\right)/A^{1/(1-\alpha)}_{0t}$. The labor needed to produce a given value of output scales with the labor wedge, which is why each sector enters weighted by $1/\tau^w_{it}$. Here $\widetilde{NX}_t$ is detrended aggregate net exports and $\bar{\varepsilon}_t$ the expenditure-weighted average income elasticity. The within-period block (prices, the non-homothetic demand system (10), and quantities) is a function of $(\tilde{c}_t, e_t)$ and the state $\tilde{k}_t$: prices and demands depend only on $(\tilde{c}_t, e_t)$, and $\tilde{k}_{0t}$ then follows from (27) given the labor allocation.[25]

The equilibrium path is therefore pinned down, given initial aggregate capital and net foreign assets $(\tilde{k}_{t=0}, \tilde{a}_{t=0})$, by convergence to the CGP, $(\tilde{k}_t, \tilde{a}_t, \tilde{c}_t, e_t) \to (\tilde{k}^*, \bar{a}, \tilde{c}^*, e^*)$.

## 6.2 Long-Run Calibration

We first calibrate the economy to the long-run patterns of structural transformation (Section 2.2) and economic growth.

There are two additional objects relative to Section 4. We allow for a capital wedge in the investment sector, $\tau^k_{0t}$, which acts as an aggregate distortion to investment. It lets the model reproduce the capital-output ratio along the development path, and it is the channel through which a capital wedge common to all sectors operates, since such

[25] Equation (23) is the capital law of motion, (24) the country budget constraint (21) in detrended form, (25) the Euler equation (9) after substituting the no-arbitrage condition (26). In the closed-economy limit ($\phi_i \to 0$) trade vanishes, (24) drops out, and (23) and (25) collapse to the one-state system of Comin *et al.* (2021).

a wedge leaves relative prices unchanged. We also parametrize the foreign demand function in (15) to be $c^*_{Hit} = \xi^*_{it}(p^*_{Hit})^{-\nu_i}$, so that the export shifters $\xi^*_{it}$ move foreign demand at a constant elasticity.

Table 4 lists the parameters we set outside the model. The preference and trade parameters are the same ones used in the decomposition of Section 5. The labor, demand, export and import wedges are held at one along the baseline transition, so the development path is driven by fundamentals alone, and they move only in the crisis experiment of Section 6.3.

Table 5 lists the parameters we calibrate inside the model, each matched to a moment along the development path. Common productivity growth matches the growth of GDP per capita. The relative productivities of agriculture and services match the sectoral value added shares. The export shifters match sectoral exports relative to value added, and the trade bias matches the home share of sectoral absorption. The investment-sector capital wedge and the initial capital stock match the capital-output ratio relative to the frontier.

**Table 4:** Externally Set Parameters

| Parameter | Meaning | Value |
|---|---|---|
| $\alpha$ | capital share | 1/3 |
| $\sigma$ | elasticity of substitution across sectors | 0.50 |
| $\varepsilon_i$ | income elasticities (AGR/MAN/SERV) | 0.11 / 1 / 1.21 |
| $\nu = \nu^*$ | trade elasticities | 4.14 |
| $\gamma_i$ | demand shifters | 1/3 each |
| $\theta$ | curvature of utility | 2.0 |
| $\beta,\ \delta$ | discount factor, depreciation | 0.96, 0.10 |
| $\psi$ | debt elasticity of the country rate | 0.10 |
| $\tau^w, \tau^c, \tau^H, \tau^F$ | labor, demand, export, import wedges | 1 |

*Notes*: Preference and trade parameters follow Comin *et al.* (2021) and Simonovska and Waugh (2014) and are the same values used in the decomposition of Section 5. The four wedges are held at one along the baseline transition, so that the development path is driven by fundamentals alone; they move only in the crisis experiment of Section 6.3.

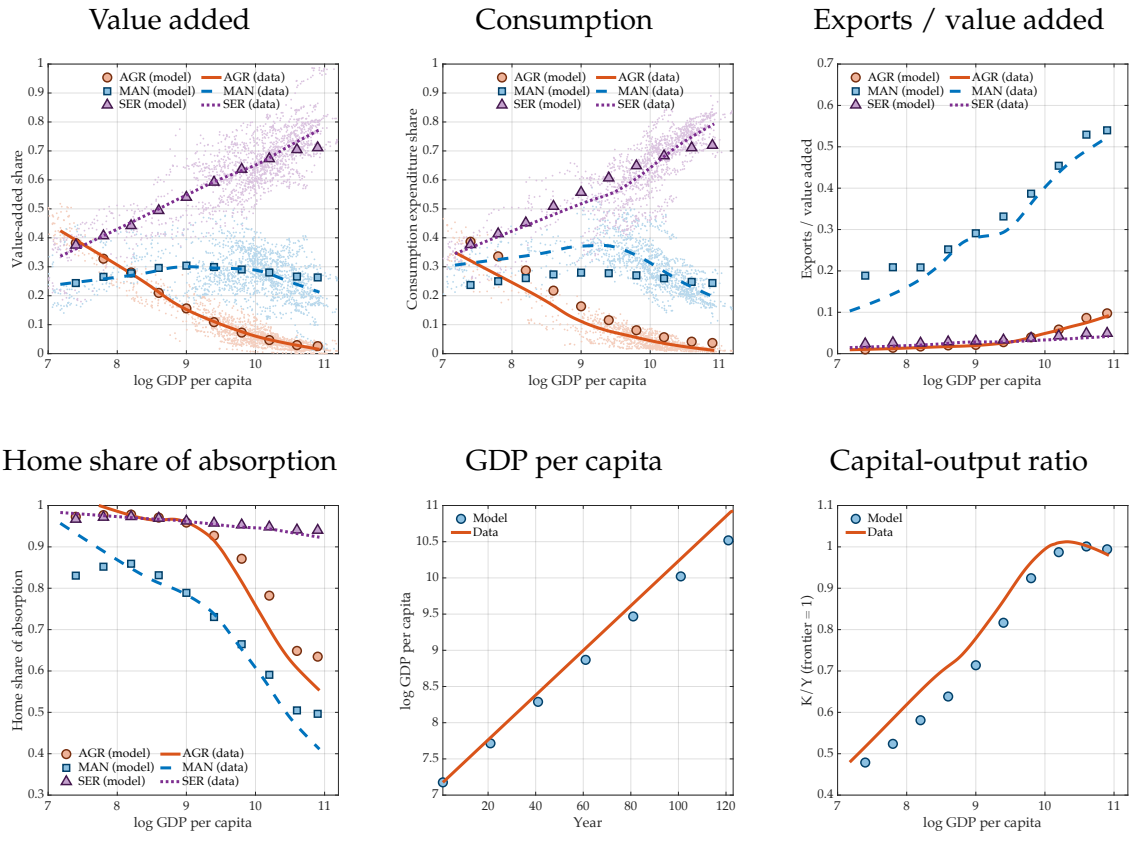
Figure 4 shows that the model closely reproduces the patterns of structural transformation and economic growth across development. These include sectoral value-added and consumption shares, trade moments (exports relative to value added and the home-goods share of absorption), GDP per capita growth, and the capital-output ratio. We target three stages of development: the low-income end, the peak of the manufacturing share, and the frontier.

**Table 5:** Internally Calibrated Parameters

| Parameter | Meaning | Targeted moment |
|---|---|---|
| $g_0 = g_{\text{MAN}}$ | common productivity growth | GDP per capita growth |
| $A_i / A_{\text{MAN}}$ | relative productivities (AGR, SERV) | value added shares |
| $\xi_i^*(t)$ | export shifters | sectoral exports / value added |
| $\phi_i(t)$ | trade bias | home share of absorption |
| $\tau_0^k(t)$ | investment-sector capital wedge | $K/Y$ relative to frontier |
| $k_0$ | initial capital | $K/Y$ poor / frontier |

*Notes*: Each parameter is chosen so that the baseline transition matches the listed moment along the development path, using WIOD and PWT data. Productivity growth and relative productivities are constant and stage-dependent respectively; the export shifters, the trade bias and the capital wedge are paths in the development clock.

**Figure 4:** Model and Data along the Development Path




*Notes*: The model's baseline transition (line) against the cross-country data (markers), both plotted against ln GDP per capita, so the horizontal axis is the stage of development rather than calendar time. Value added and consumption shares are sectoral shares of the three-sector total. The value added shares, sectoral exports and the home share of absorption are targeted in the calibration; GDP per capita and the capital-output ratio discipline the growth rate and the capital wedge.

## 6.3 Simulating a Crisis

We model a crisis as an unanticipated (MIT) shock to fundamentals. For our baseline calibration, we assume that the crisis hits the economy at the same level of development as the average crisis in our data.[26] To capture the relative smoothness we observe in the data, we assume the shock unravels gradually over a six-year period. Table 6 reports the paths, as log changes relative to the no-crisis path, together with the moment each one targets. The shocks are chosen jointly to fit the estimated post-crisis responses of Section 3.[27] They settle at permanent changes in *levels*, so by Proposition 2 the economy converges to the same constant growth path.

**Table 6:** Changes in fundamentals in a crisis

| Change in fundamentals | year 1 | year 3 | year 6 | Most informative moment |
|---|---|---|---|---|
| Common TFP $\lambda$ | $-2.5\%$ | $-8.5\%$ | $-7.1\%$ | consumption, GDP |
| Agriculture relative TFP | $-9\%$ | $+32\%$ | $+27\%$ | VA AGR/MAN |
| Services relative TFP | $+7\%$ | $+1\%$ | $-4\%$ | REER on impact |
| Capital wedge $\tau^k$ | $-31\%$ | $-11\%$ | $+11\%$ | GDP, consumption |
| Services export demand $\xi^*_{\text{SERV}}$ | $+70\%$ | $+20\%$ | $-50\%$ | VA SERV/MAN |
| Import wedge $\tau^F$ (all sectors) | $-2\%$ | $-4\%$ | $-17\%$ | REER |
| Labor and demand wedges | from the decomposition | | | Section 5.1 |

*Notes*: Log changes in each fundamental relative to its no-crisis path, at the three knots of the shock profile. The path is linear between knots and flat at the settled value thereafter. All shocks are chosen jointly to fit the seven estimated responses, so the last column names the moment each shock is most informative about rather than a moment it alone matches. Investment is *not* targeted and is reported as a prediction in Figure 5, and net exports, also untargeted, in Appendix B.5. The labor and demand wedge paths are taken from the decomposition of Section 5.1 rather than calibrated, and are rescaled each period so that the value-added-weighted mean of $\Delta \log \tau^w$ and the expenditure-weighted mean of $\Delta \log \gamma$ are both zero.

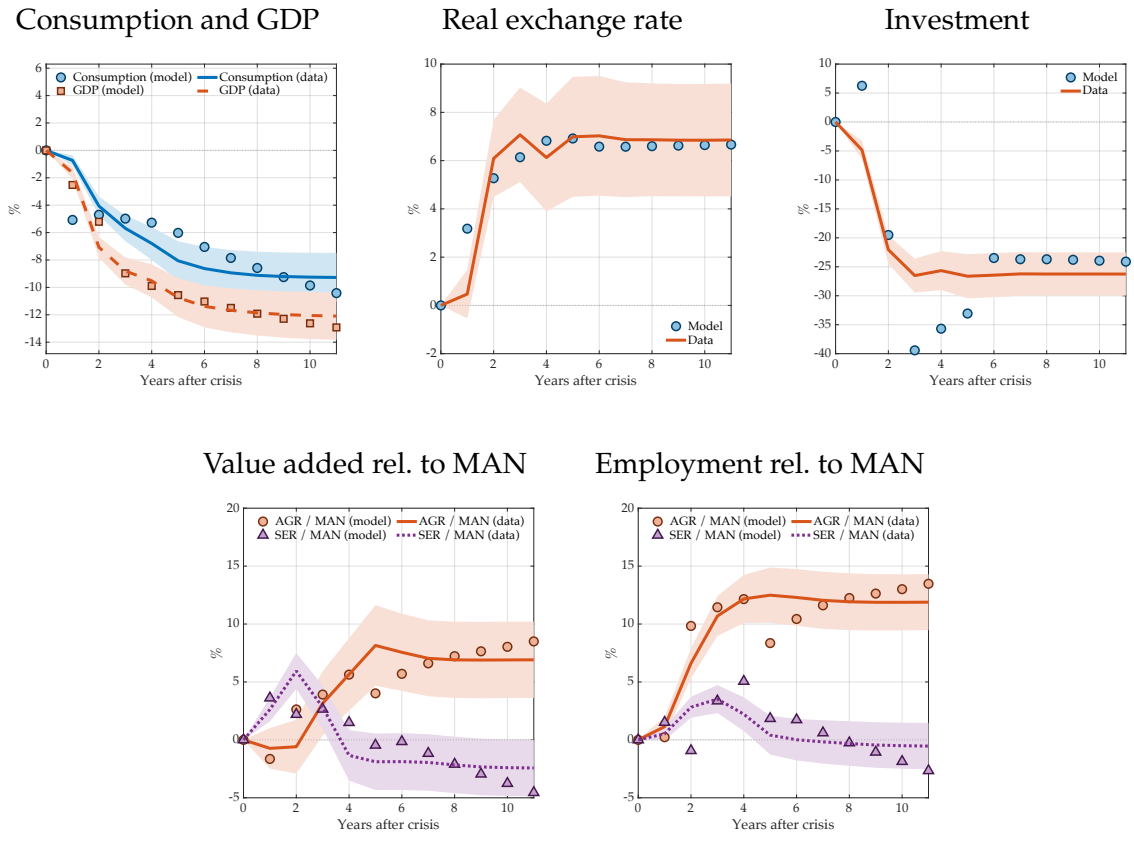
The labor and demand wedges are not calibrated here. We feed in the paths recovered from the accounting decomposition of Section 5.1, so that the wedges the model uses in the crisis are the ones measured in the data. What is calibrated to crisis moments is therefore a smaller set of fundamentals: common and sectoral productivities, the capital wedge, the services export shifter and the import wedge.

Figure 5 compares the simulated crisis with the estimated responses of Section 3.

[26] Because we use the WIOD sample, the level is higher, close to the 75th percentile of income at onset in our whole sample.

[27] The seven series are aggregate consumption, GDP, the real exchange rate, and value added and employment in agriculture and services relative to manufacturing. Taken over the eleven years after onset they give 77 residuals, which we minimize by nonlinear least squares on the stacked deviations with equal weight on each series. The one fundamental restricted not to settle at a permanent level change is the country interest-rate premium, which must return to zero, since a permanent change in the world rate would move the constant growth path itself.

**Figure 5:** Model and Data after a Crisis




*Notes*: Responses to a crisis by years since onset. Markers are the model; lines are the estimated responses of Section 3 with ±1 standard error bands. The crisis hits at ln GDP per capita of 10. Consumption, GDP, the real exchange rate and the two sectoral panels are among the seven targeted series; investment is *not* targeted and is a prediction of the model. A rise in the real exchange rate is a depreciation.

The model closely reproduces the persistent contraction in consumption and output, the real depreciation, and the reallocation of value added and employment toward agriculture and away from services relative to manufacturing. Those series are among the seven the shocks are chosen to fit. Investment is not, and the model still reproduces its dynamics.[28]

## 6.4 Main Results

We report four results. The first asks what the distortions measured in Section 5 contribute once the economy responds in equilibrium. The next two examine how the same post-crisis changes in fundamentals affect economies at different stages of development and why trade plays a crucial role in these differences. The last measures the

[28] Net exports, also untargeted, is reported in Appendix B.5.

cost of a crisis in years of structural change lost.

**The Role of Distortions.** The wedges we measure in Section 5 enter the model as data rather than as fitted parameters, so we can ask what they contribute once the economy responds in equilibrium. Table 7 re-solves the identified crisis with each fundamental held at its no-crisis path in turn. The wedges matter most for services. Without them the services share falls by about 15% over the decade rather than about 5%, so the measured distortions are what hold services up after a crisis. For agriculture they matter less, taking it from +8.5% to +5.6% relative to manufacturing after eleven years. That is less than the roughly 7% the two wedges account for in the accounting. In equilibrium the other channels adjust, so part of what the accounting assigns to the wedges is taken up elsewhere.

**Table 7:** The Identified Crisis with One Fundamental Removed

| | VA AGR / MAN | | VA SERV / MAN | |
|---|---|---|---|---|
| Years after the crisis: | 1 | 11 | 1 | 11 |
| The crisis (all shocks) | −1.6 | +8.5 | +3.6 | −4.6 |
| without demand and labor wedges | −2.3 | +5.6 | +3.4 | −14.6 |
| without common TFP | +0.7 | +5.5 | +9.0 | −4.1 |
| without agriculture relative TFP | +0.4 | −13.0 | +2.2 | −7.9 |
| without services relative TFP | −1.4 | +9.2 | +2.7 | −2.9 |
| without capital wedge | −6.7 | +7.8 | −2.3 | −5.6 |
| without services export shifter | −3.7 | +11.1 | −4.1 | +1.9 |
| without import wedge | +2.9 | +17.6 | +9.3 | +8.4 |

*Notes*: Percent deviation of the value added share relative to manufacturing from the no-crisis path, for the crisis identified at ln GDP per capita of 10. Each row below the first re-solves the model with that fundamental held at its no-crisis path and every other fundamental unchanged, so a row's distance from the first row measures that fundamental's contribution. The demand and labor wedges are the paths measured in Section 5.1.

**Crisis at Different Stages of Development.** The same change in fundamentals does not have the same consequences at every income level. Table 8 applies the identified crisis to an economy at ln GDP per capita of about 7.2 and to one at about 10.0, the two ends of our development range.[29] By the eleventh year agriculture has moved in opposite directions, with its share falling by about 5% relative to manufacturing in the poorer economy and rising by about 9% in the richer one. Services does the reverse, rising in the poorer economy and falling in the richer one. Removing the rise

[29] Table B.9 in Appendix B.6 reports the responses one year after onset.

in agricultural productivity reverses the agricultural response in both economies, while removing the change in services productivity barely moves it. The reversal therefore comes from the rise in agricultural productivity relative to manufacturing that is part of the identified crisis (Table 6), rather than from the other changes in fundamentals.

**Table 8:** The Same Shock at Different Stages of Development

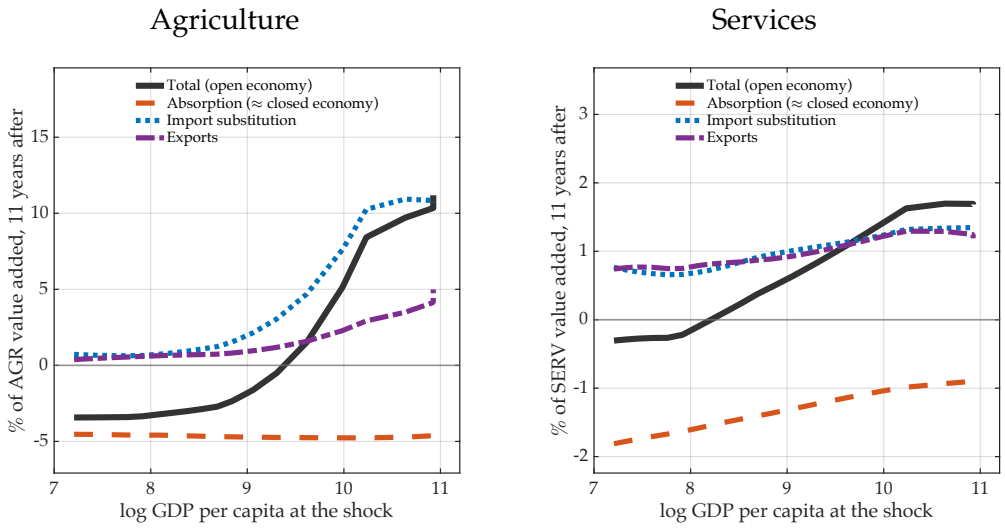
| | VA AGR / MAN | | VA SERV / MAN | |
|---|---|---|---|---|
| Crisis in the: | poorer | richer | poorer | richer |
| The crisis (all shocks) | −5.1 | +8.5 | +10.2 | −4.6 |
| without AGR relative TFP | +4.7 | −13.0 | +5.6 | −7.9 |
| without SERV relative TFP | −5.3 | +9.2 | +9.8 | −2.9 |

*Notes*: Percent deviation of the value added share relative to manufacturing from the no-crisis path, eleven years after onset. Table B.9 reports the same exercise one year after onset. The same identified change in fundamentals is applied to an economy at ln GDP per capita of about 7.2 and to one at about 10.0, so the columns differ only in where the crisis hits. Each row below the first re-solves the model with that fundamental held at its no-crisis path, so a row's distance from the first row is that fundamental's contribution.

**The Role of Trade.** To illustrate why the effect of this change depends on the stage of development, Figure 6 traces the effect of a 10% rise in a sector's productivity relative to manufacturing, applied at each stage of development, for agriculture and for services. For agriculture two forces work against each other. Higher productivity lowers the relative price and, because sectors are complements, lowers domestic spending on food, so the share falls. In an open economy the cheaper home good also displaces imports and raises exports, so the share rises. The first force dominates in poor economies, which trade little, and the second in richer economies, which are more open. The sign of the response therefore depends on how open the sector is, which rises with development.

Services behaves differently, and the reason is that it barely trades. Imports and exports are about 5% of services at every stage, so domestic spending alone sets the size of the response and trade never takes over. A productivity shock is consequently a weak lever on the services share, which is why reproducing the observed movement of services during a crisis requires a shock on the demand side rather than to productivity.

**Figure 6:** The Role of Trade




*Notes*: Effect on the sector's value added share relative to manufacturing of a +10% change in that sector's relative productivity, applied separately at each stage of development on the horizontal axis. The response is split into the absorption channel — the relative price falls and, with complements, domestic spending on the sector falls — and the trade channel, which works through imports displaced and exports gained.

**Crises and Structural Change Delays.** We now express the crisis in years of development. Structural change is slow, so a crisis that moves employment away from its no-crisis path costs the economy a number of years of ordinary structural change. We measure that number by taking the discounted gap between the crisis and no-crisis paths of employment relative to manufacturing and dividing it by the pace at which that ratio normally moves along the development path,

$$\text{delay}_i = -\frac{\sum_{\tau=1}^{T} \beta^\tau \left[\rho^c_{i,t_0+\tau} - \rho^b_{i,t_0+\tau}\right] / \sum_{\tau=1}^{T} \beta^\tau}{\text{average annual pace of } \rho_i},$$

where $\rho_i = \log(L_i/L_{\text{MAN}})$, $\beta = 0.96$ and $T = 40$. A positive number means the economy is set back, a negative one that it is pushed ahead. Measuring each sector relative to manufacturing gives the delay a single interpretation. The manufacturing share is hump-shaped in income, so a rise in it can mean faster or slower structural change depending on the stage of development. Relative to manufacturing, instead, agriculture declines and services rises along the development path, both in the data and in the baseline transition beyond the very earliest stages. A crisis that raises agriculture relative to manufacturing therefore sets the economy back, and one that raises services

relative to manufacturing pushes it ahead.

Table 9 reports the result. A single crisis sets agriculture back by about seven years relative to manufacturing and services by about eleven, and costs about five years of GDP per capita. Weighting the sectoral gaps by the pace of development gives a development clock of about seven years.[30] The number is not a welfare cost. The long-run destination is unchanged by construction, so the clock measures how long the economy takes to regain the ground it lost at its own average pace. It is still large, because that pace is slow, with the sectoral composition of a developing economy moving by a few percent a year, and because emerging economies have crises repeatedly, so the setbacks accumulate over the course of development.

**Table 9:** The Delay of a Crisis in Years of Development

| | Years of development lost |
|---|---|
| AGR / MAN | 6.6 (16) |
| SERV / MAN | 10.6 (−5) |
| GDP per capita | 4.7 (13) |
| Development clock | 6.8 |

*Notes*: Years of development lost, so a larger number means a bigger setback. A negative entry would mean the economy is pushed ahead. Each entry is the discounted average gap between the crisis and no-crisis paths over forty years, shown in parentheses in log points, divided by the average annual movement of that ratio along the baseline development path. Gap and pace carry signs, so a ratio that falls with development and is pushed up by the crisis still registers as a setback. The development clock weights the sectoral gaps by their pace.

# 7 Conclusions

Do crises shape the economic structure? They do, and they slow structural change rather than speed it. Across 79 countries and 102 episodes we find a large and persistent reallocation toward agriculture, whose employment share is about 5% higher a decade after a crisis with no sign of reverting, and away from services.

The standard forces of structural transformation explain little of this. Income and price effects work against each other and together account for about a sixth of the measured reallocation toward agriculture. Trade separates agriculture from services, and what remains is a persistent rise in labor and demand distortions that does not

[30] The clock is the shift in time along the average direction of development that best fits the discounted gaps, $dt = -\langle \text{gap}, \text{pace} \rangle / \langle \text{pace}, \text{pace} \rangle$. Weighting by the pace gives little weight to the slow-moving ratio, so the clock is not inflated by it.

fade over the decade. Feeding those measured distortions into the model's equilibrium transition, we find that a single crisis costs about seven years of structural change. Because emerging economies are hit by crises repeatedly, these setbacks accumulate over the course of development.

How much a crisis costs depends on where it strikes. The same change in fundamentals can lower the agricultural share in a very poor economy while raising it in one near the frontier. The reason is trade. When a sector barely trades, higher productivity lowers its relative price and, with complements, reduces spending on it, so its share falls. Once the sector is open to trade, the cheaper home good displaces imports and exports rise, increasing the sector's share instead. Openness rises with development, so the same crisis can push a poor economy along its path while setting a richer one back. This is consistent with the smaller post-crisis reallocation to agriculture we observe in poor economies.

What drives the heterogeneous and persistent changes in labor and demand distortions across sectors remains an open question. Are they the result of persistent policy shifts, such as changes in regulations or taxes that affect sectors differentially, or do they reflect the interaction of fundamental shocks with preexisting market frictions that pushes the economy toward a new equilibrium? Understanding these mechanisms, and evaluating how crisis-management policies shape the long-run reallocation of economic activity, is an important avenue for future research.

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# A Data Appendix

**Table A.1:** List of Countries in Baseline Sample

| Code | Category | Country | Period | Crisis |
|---|---|---|---|---|
| ARG | Emerging | Argentina | 1950-2018 | 1951,1956,1980,1989,1995,2001,2014 |
| AUS | Developed | Australia | 1984-2018 | |
| AUT | Developed | Austria | 1970-2019 | 2008 |
| BEL | Developed | Belgium | 1970-2019 | 2008 |
| BFA | Emerging | Burkina Faso | 1965-2018 | 1990 |
| BGD | Emerging | Bangladesh | 1990-2018 | |
| BGR | Emerging | Bulgaria | 1995-2019 | 1996 |
| BOL | Emerging | Bolivia | 1950-2018 | 1980,1986,1994 |
| BRA | Emerging | Brazil | 1950-2018 | 1961,1983,1990 |
| CAN | Developed | Canada | 1970-2019 | |
| CHE | Developed | Switzerland | 1991-2018 | 2008 |
| CHL | Emerging | Chile | 1950-2018 | 1961,1976,1981 |
| CHN | Emerging | China | 1952-2018 | 1998 |
| CMR | Emerging | Cameroon | 1965-2018 | 1987,1995 |
| COL | Emerging | Colombia | 1950-2018 | 1982,1998 |
| CRI | Emerging | Costa Rica | 1950-2018 | 1962,1981,1987,1994 |
| CZE | Developed | Czech Republic | 1995-2019 | 1996 |
| DEU | Developed | Germany | 1970-2019 | 2008 |
| DNK | Developed | Denmark | 1948-2019 | 2008 |
| ECU | Emerging | Ecuador | 1990-2018 | 1998,2008 |
| EGY | Emerging | Egypt | 1960-2018 | 1980 |
| ESP | Developed | Spain | 1956-2019 | 1977,2008 |
| ETH | Emerging | Ethiopia | 1961-2018 | |
| FIN | Developed | Finland | 1970-2019 | 1991 |
| FRA | Developed | France | 1954-2019 | 2008 |
| GBR | Developed | United Kingdom | 1948-2019 | 2007 |
| GHA | Emerging | Ghana | 1960-2018 | 1966,1982 |
| GRC | Developed | Greece | 1970-2019 | 2008 |
| HKG | Developed | Hong Kong | 1970-2018 | |
| HRV | Emerging | Croatia | 1995-2019 | 1998 |
| HUN | Emerging | Hungary | 1991-2019 | 1991,2008 |
| IDN | Emerging | Indonesia | 1966-2018 | 1966,1997 |
| IND | Emerging | India | 1950-2018 | 1958,1969,1993 |
| IRL | Developed | Ireland | 1970-2019 | 2008 |
| ISR | Developed | Israel | 1990-2018 | |
| ITA | Developed | Italy | 1951-2019 | 2008 |
| JPN | Developed | Japan | 1953-2018 | 1997 |
| KEN | Emerging | Kenya | 1960-2018 | 1985,1992 |
| KHM | Emerging | Cambodia | 1990-2018 | |
| KOR | Developed | South Korea | 1953-2018 | 1997 |
| LAO | Emerging | Laos | 1990-2018 | |
| LKA | Emerging | Sri Lanka | 1990-2018 | |
| LSO | Emerging | Lesotho | 1964-2018 | |
| LTU | Emerging | Lithuania | 1995-2019 | 1995 |
| LVA | Emerging | Latvia | 1995-2019 | 1995,2008 |

*Notes*: Table shows the countries in our baseline sample. The period refers to the data coverage period. Crisis refers to the dates that a crisis episode happens.

**Table A.2:** List of Countries in Baseline Sample (cont.)

| Code | Category | Country | Period | Crisis |
|---|---|---|---|---|
| MAR | Emerging | Morocco | 1960-2018 | 1980 |
| MEX | Emerging | Mexico | 1950-2018 | 1981,1994 |
| MMR | Emerging | Myanmar | 1990-2018 | |
| MOZ | Emerging | Mozambique | 1966-2018 | 1984 |
| MWI | Emerging | Malawi | 1960-2018 | 1982 |
| MYS | Emerging | Malaysia | 1970-2018 | 1997 |
| NGA | Emerging | Nigeria | 1960-2018 | 1983,1991,2009 |
| NLD | Developed | Netherlands | 1959-2019 | 2008 |
| NOR | Developed | Norway | 1970-2018 | 1991 |
| NPL | Emerging | Nepal | 1990-2018 | |
| NZL | Developed | New Zealand | 1971-2018 | |
| PAK | Emerging | Pakistan | 1990-2018 | |
| PER | Emerging | Peru | 1950-2018 | 1969,1978,1983 |
| PHL | Emerging | Philippines | 1971-2018 | 1983,1997 |
| POL | Developed | Poland | 1995-2019 | |
| PRT | Developed | Portugal | 1970-2019 | 2008 |
| ROU | Emerging | Romania | 1995-2019 | 1998 |
| RWA | Emerging | Rwanda | 1966-2018 | |
| SEN | Emerging | Senegal | 1960-2018 | 1981,1988 |
| SGP | Developed | Singapore | 1970-2018 | |
| SVK | Emerging | Slovakia | 1995-2019 | 1998 |
| SVN | Developed | Slovenia | 1995-2019 | 2008 |
| SWE | Developed | Sweden | 1960-2019 | 1991,2008 |
| THA | Emerging | Thailand | 1951-2018 | 1983,1997 |
| TUN | Emerging | Tunisia | 1990-2018 | 1991 |
| TUR | Emerging | Turkey | 1990-2018 | 2000 |
| TWN | Emerging | Taiwan | 1951-2018 | 1983,1995 |
| TZA | Emerging | Tanzania | 1960-2018 | 1984 |
| UGA | Emerging | Uganda | 1955-2018 | 1981,1994 |
| USA | Developed | United States | 1947-2019 | 1988,2007 |
| VEN | Emerging | Venezuela | 1950-2012 | 1982,1994 |
| VNM | Emerging | Vietnam | 1990-2018 | 1997 |
| ZAF | Emerging | South Africa | 1960-2018 | 1985 |
| ZMB | Emerging | Zambia | 1960-2018 | 1983,1995 |

*Notes*: Table shows the countries in our baseline sample. The period refers to the data coverage period. Crisis refers to the dates that a crisis episode happens.

**Table A.3:** Sectoral Shares Distribution: Disaggregated Sectors

| | Employment | | | | Value Added | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | P25 | P50 | P75 | Mean | P25 | P50 | P75 |
| *a. All* | | | | | | | | |
| Goods | 57 | 38 | 56 | 76 | 43 | 32 | 42 | 52 |
| Agriculture | 38 | 11 | 32 | 64 | 18 | 5 | 12 | 29 |
| Manufacturing | 18 | 11 | 17 | 25 | 24 | 18 | 24 | 30 |
| Services | 43 | 24 | 44 | 62 | 57 | 48 | 58 | 68 |
| Wholesale/Retail Trade | 20 | 12 | 22 | 27 | 20 | 17 | 20 | 23 |
| Transport | 7 | 3 | 6 | 10 | 9 | 5 | 8 | 12 |
| Finance and Real Estate | 9 | 2 | 6 | 14 | 25 | 17 | 24 | 32 |
| Other Services | 7 | 4 | 6 | 9 | 4 | 3 | 4 | 5 |
| *b. Crisis Window* | | | | | | | | |
| Goods | 56 | 37 | 55 | 76 | 42 | 32 | 44 | 52 |
| Agriculture | 38 | 13 | 32 | 66 | 16 | 6 | 13 | 23 |
| Manufacturing | 18 | 12 | 18 | 24 | 26 | 20 | 26 | 31 |
| Services | 44 | 24 | 45 | 63 | 58 | 48 | 56 | 68 |
| Wholesale/Retail Trade | 20 | 12 | 20 | 26 | 20 | 17 | 20 | 23 |
| Transport | 7 | 3 | 6 | 10 | 9 | 5 | 7 | 12 |
| Finance and Real Estate | 9 | 2 | 5 | 14 | 25 | 17 | 23 | 32 |
| Other Services | 9 | 5 | 7 | 10 | 5 | 3 | 4 | 5 |

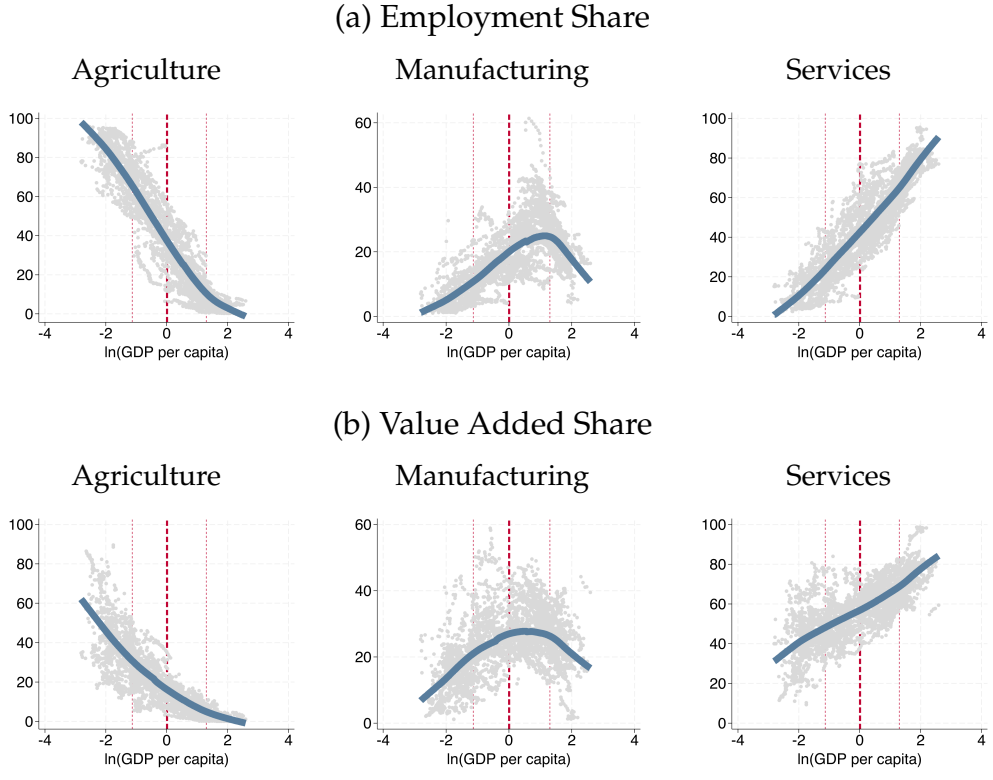
*Notes*: Table shows the value added and employment shares for each sector. Panel (a) shows for all the sample, and Panel (b) the values around crisis. Services includes wholesale and retail trade, transportation, finance and real estate activities, and other services. Shares exclude construction and mining from the total.
*Data source*: Penn World Tables, and Groningen Growth and Development Center.

**Table A.4:** Crisis Predictors: First Stage LP-IPW

| | Probit: Prob(crisis) | | |
|---|---|---|---|
| Predictor | Baseline | Sov. Debt | Banking |
| Credit growth (3 years before) | 5.551*** | 7.996** | 5.276*** |
| | (0.001) | (0.033) | (0.004) |
| GDP growth (3 years before) | -2.362 | -10.060*** | 0.338 |
| | (0.139) | (0.000) | (0.856) |
| Credit level (1 year before) | 0.014* | 0.002 | 0.021** |
| | (0.100) | (0.889) | (0.022) |
| GDP level (1 year before) | -0.006 | 0.385 | -0.253 |
| | (0.987) | (0.520) | (0.501) |
| Pseudo-$R^2$ | 0.07 | 0.11 | 0.07 |
| Country FE | Y | Y | Y |
| Observations | 2,302 | 1,045 | 2,204 |

*Notes*: The table shows the estimates of the first stage of the LP-IPW model. The predictors include the last three years' growth of credit and GDP, as well as their levels in the preceding period. Details on the data are in the text. The values in parentheses are the p-values. Asterisks indicate the level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

**Figure A.1:** Structural Transformation Patterns



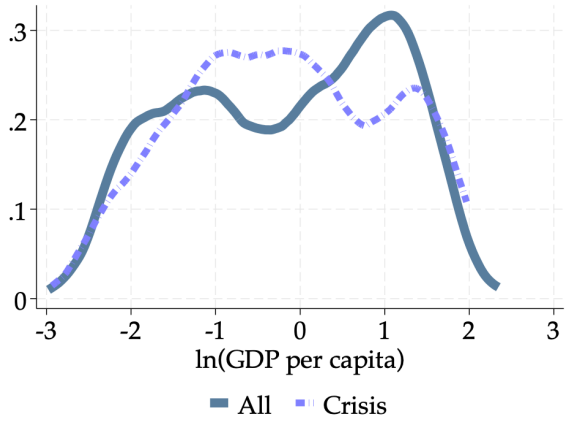

*Notes*: The figure shows the share of value added and employment across the level of income, measure in terms of log GDP per capita PPP. The log GDP is normalized by 0 relative to the sample's median. Each point is a country-year observation and the solid lines are the locally weighted smoothing of observed shares. Services includes wholesale and retail trade, transportation, finance and real estate activities, and other services. Shares exclude construction and mining from the total. The vertical lines are the 20th, 50th and 80th percentiles of income at crisis onset.
*Data source*: Penn World Tables, and sectoral data sources described in Section 2.1.

**Figure A.2:** Structural Transformation: Disaggregated Sectors




*Notes*: The figure shows the share of value added and employment across the level of income, measure in terms of log GDP per capita PPP. The log GDP is normalized by 0 relative to the sample's median. Each point is a country-year observation and the solid lines are the locally weighted smoothing of observed shares. Shares exclude construction and mining from the total. The vertical lines are the 20th, 50th and 80th percentiles of income at crisis onset.
*Data source*: Penn World Tables, and Groningen Growth and Development Center.

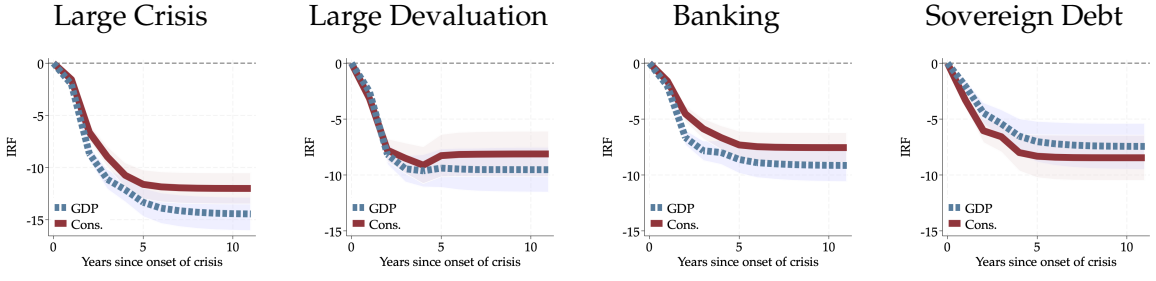
**Figure A.3:** Output per Capita Distribution



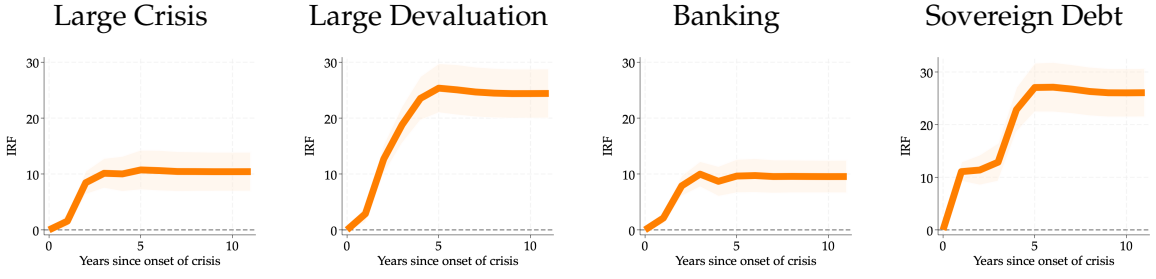

*Notes*: The Figure shows the distribution of the log GDP per capita PPP for all the observations in our baseline sample, around a banking crisis, and around a sovereign debt crisis. The log GDP is normalized by 0 relative to the sample's median. The windows around the crisis are defined between the two years before and two years after the onset of the crisis. Data source: Penn World Tables and baseline crisis episodes.

**Figure A.4:** Macro Dynamics During Crises: Other Types

(a) Aggregate Output and Consumption

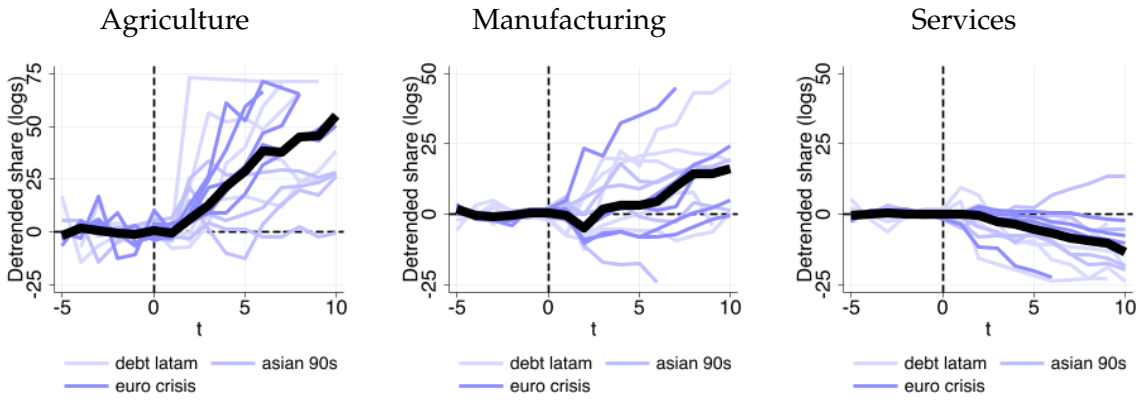



(b) Real Exchange Rate



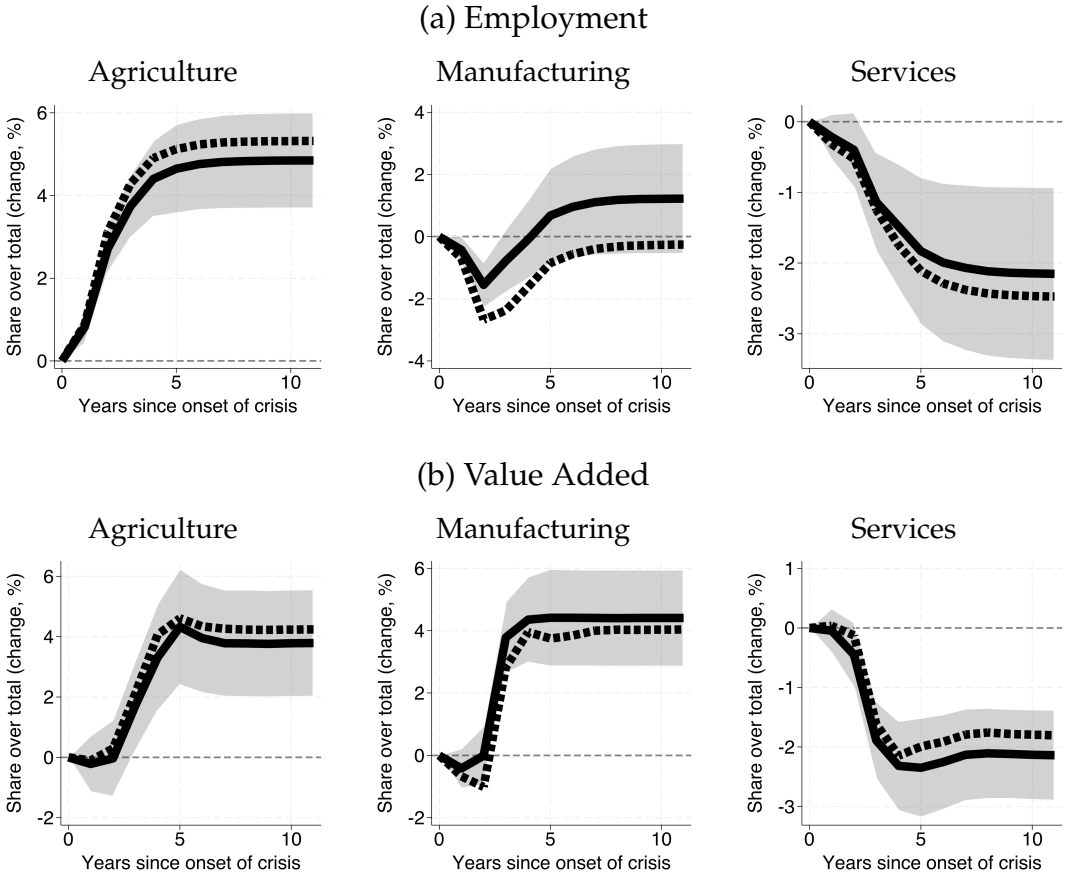

*Notes*: The Figure shows the IRF of aggregate real output per capita (GDP), consumption per capita (Cons.), and the real exchange (REER) for the episode with large GDP growth reversals, episodes with large devaluations, banking crises, and sovereign debt crises using empirical model (1). The impulse response shows the estimated percentage point impact on real GDP from a crisis using the estimated coefficients. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. Further details regarding the sectoral data and crisis episodes definitions are in Section 2.
*Data sources*: described in Section 2.1.

**Figure A.5:** Sectoral Reallocation during Crisis: Selected Episodes, Raw Value Added



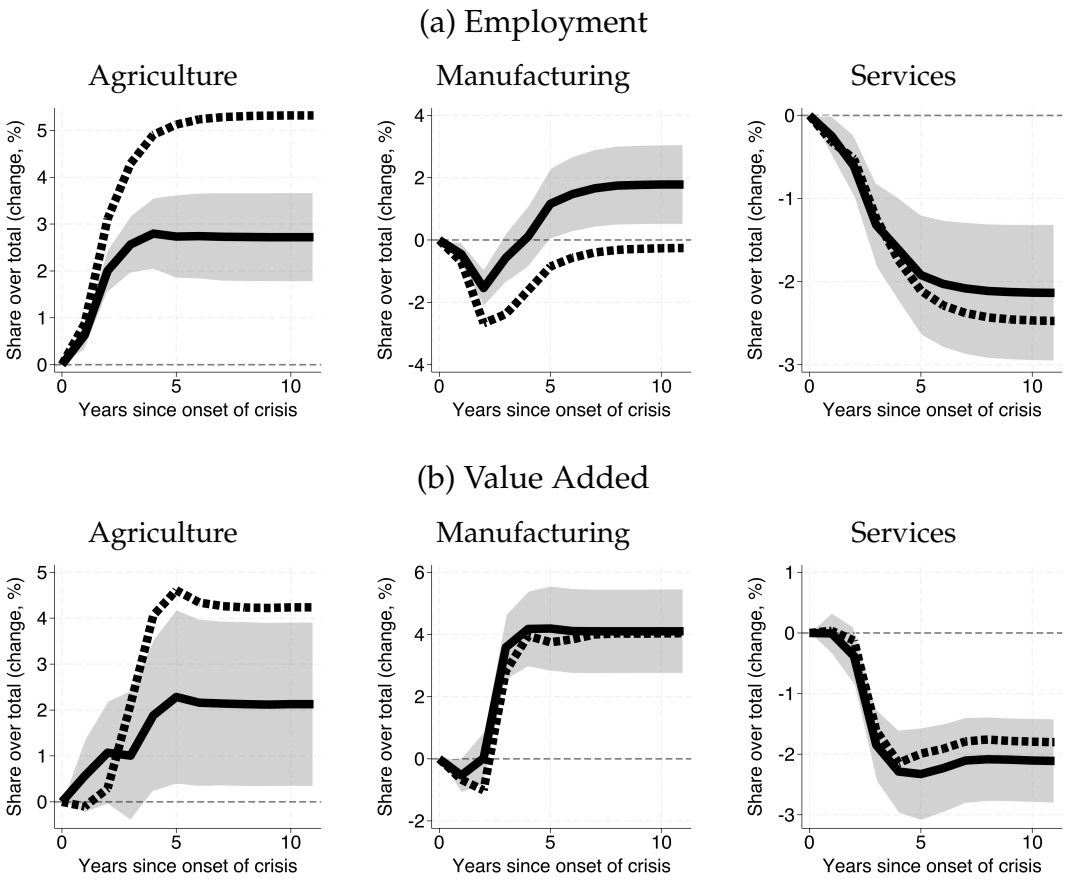

*Notes*: The figure shows the evolution of de-trended value added shares for the crisis episodes of Figure 2, in log points. We de-trend the series by subtracting the log trend from the six years preceding the crisis. The solid black line is the average across episodes.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.6:** Sectoral Reallocation during Crisis, Including Year Fixed Effects



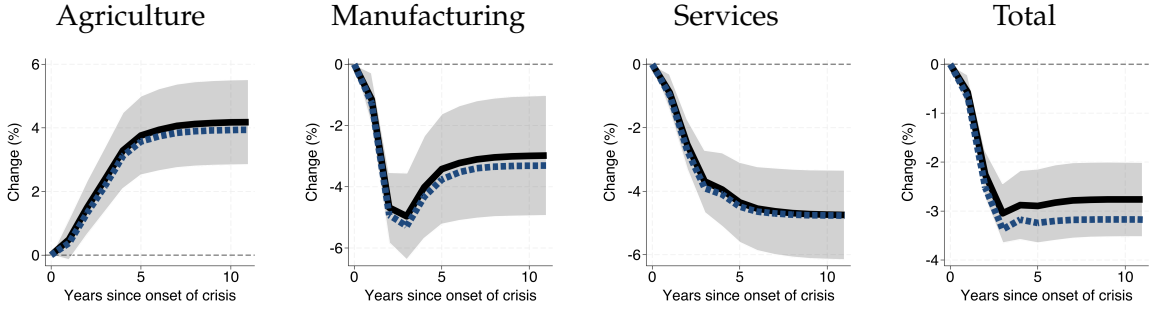

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2) including year fixed effects. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.7:** Sectoral Reallocation during Crisis, Weighted by Shares



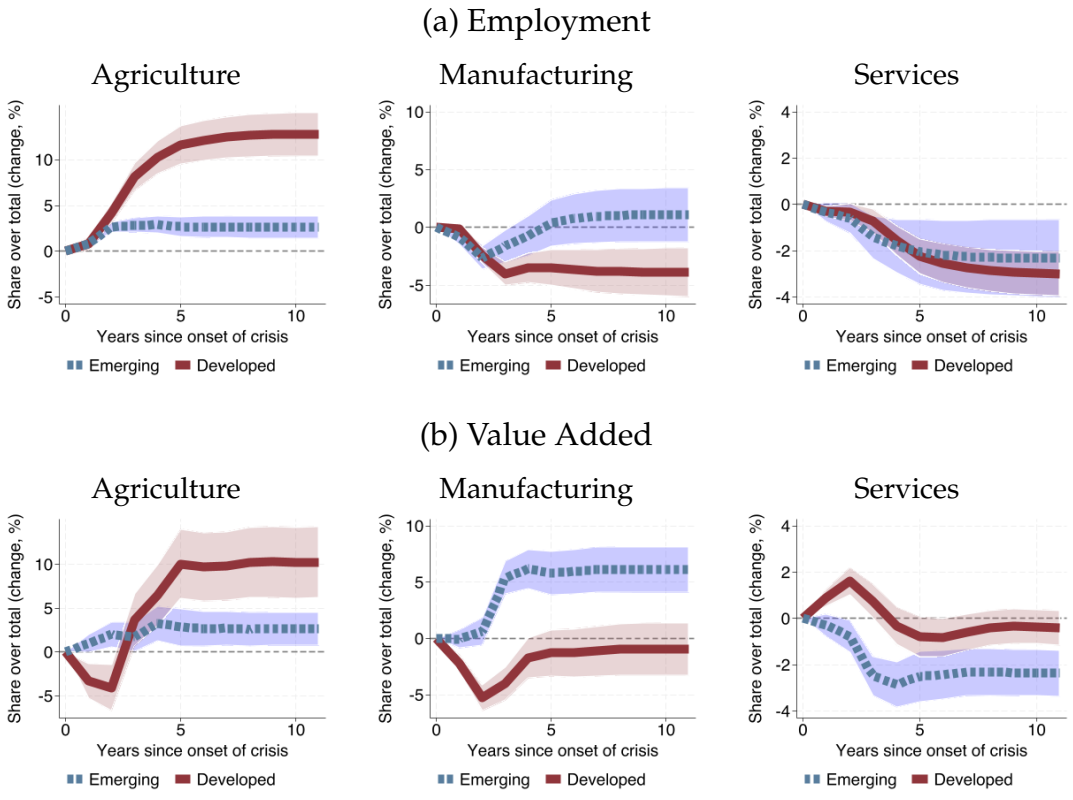

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2) weighting each country by its average sectoral employment or value added share. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.8:** Employment Levels during Crisis



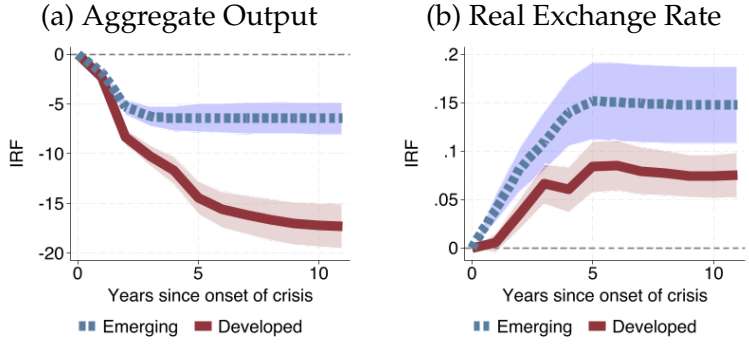

*Notes*: The figure shows the impulse response of sectoral employment in levels (solid line) and over population (dashed line) to a crisis episode, estimated with Equation (2). Total employment includes construction. Both series are estimated on the same sample, so the gap between the two lines is the response of population, which is about $-0.5\%$ ten years after the crisis. Shaded areas represent one standard deviation error bands of the series in levels.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.9:** Sectoral Reallocation during Crisis: Emerging vs Developed



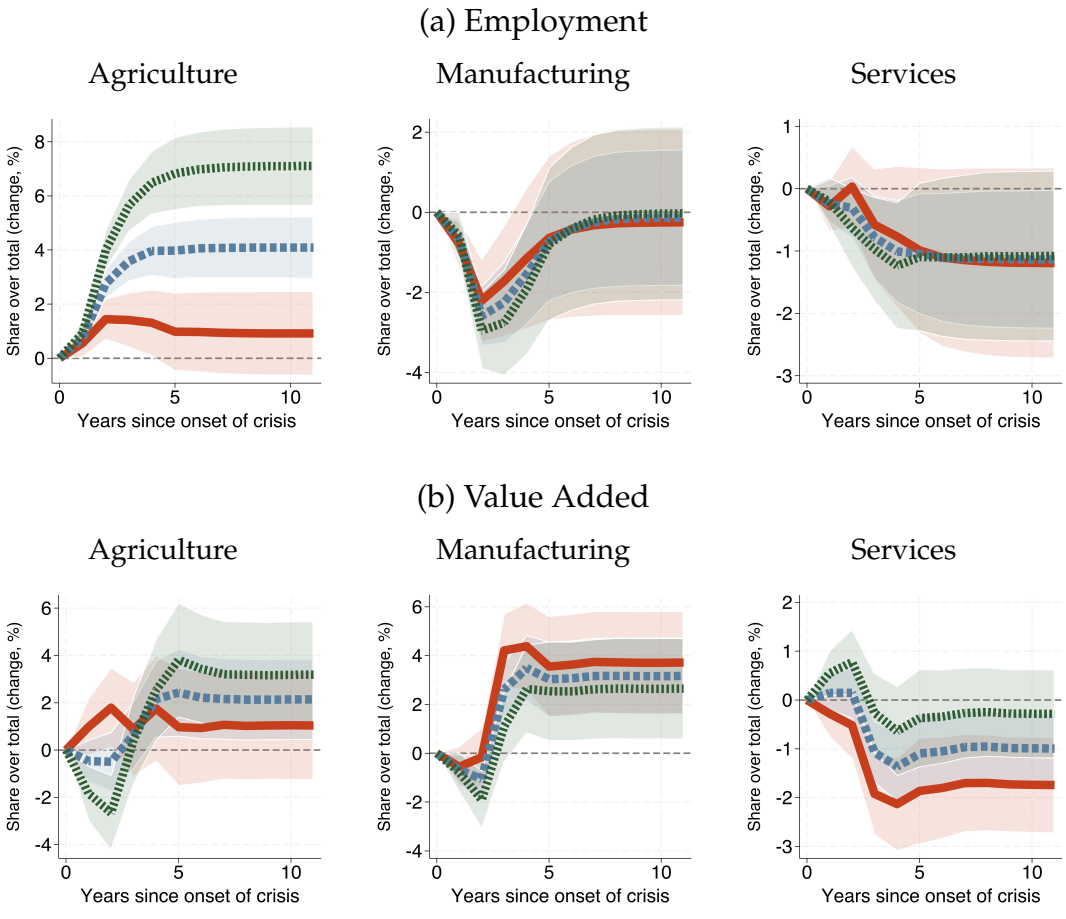

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2) for Emerging and Developed Economies. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.10:** Macro Dynamics During Crises: Emerging vs Developed



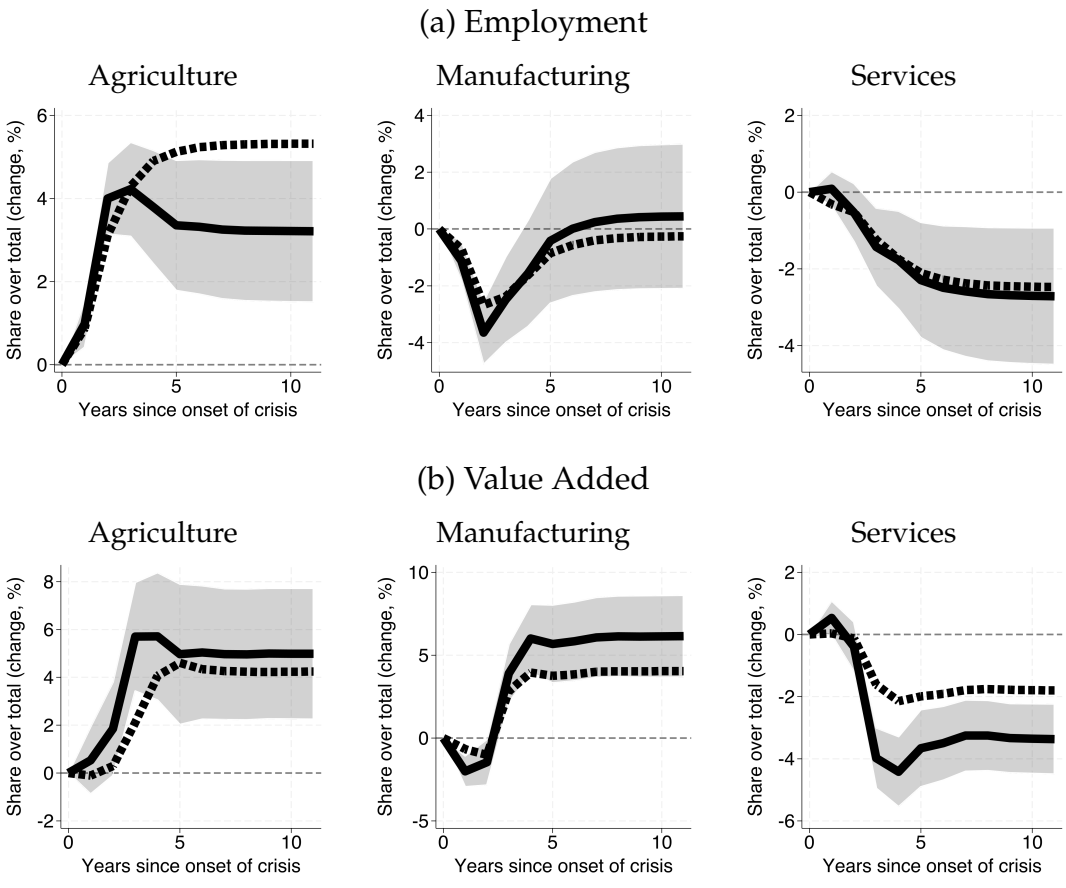

*Notes*: The Figure shows the IRF of aggregate real output per capita (GDP), and the real exchange (REER) for the baseline crisis episodes for emerging and developed economies: $g_{it} = \alpha_i + \sum_{j=1}^{4} \beta_j g_{it-j} + \sum_{s=1}^{4} \gamma_s D_{it-s} + \varepsilon_{it}$ for country $i$ in year $t$ where $\alpha_i$ is a country fixed effect, $g_{it}$ is the percentage change in real GDP/C/REER, and $D_{it}$ is a dummy variable indicating the first year of a crisis. The impulse response shows the estimated percentage point impact on real GDP from a crisis using the estimated coefficients. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. Further details regarding the sectoral data and crisis episodes definitions are in Section 2.
*Data sources*: described in Section 2.1.

**Figure A.11:** Sectoral Reallocation during Crisis: Income at Onset



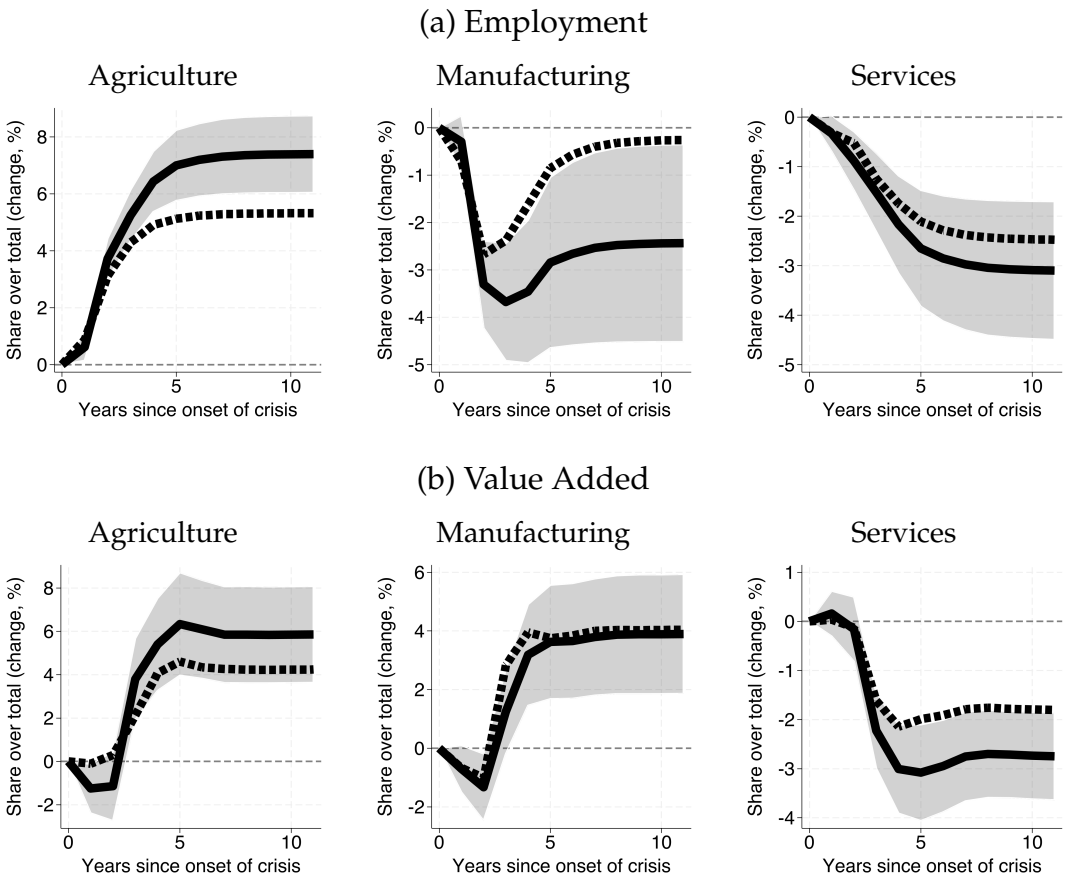

*Notes*: The figure shows the impulse response of the employment and value added shares to a crisis episode, with the crisis dummies interacted with GDP per capita before the crisis, evaluated at the 20th (solid line), 50th (dashed line) and 75th (short-dashed line) percentiles of income at onset. Shaded areas represent one standard deviation error bands.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.12:** Sectoral Reallocation during Crisis: Large Devaluation



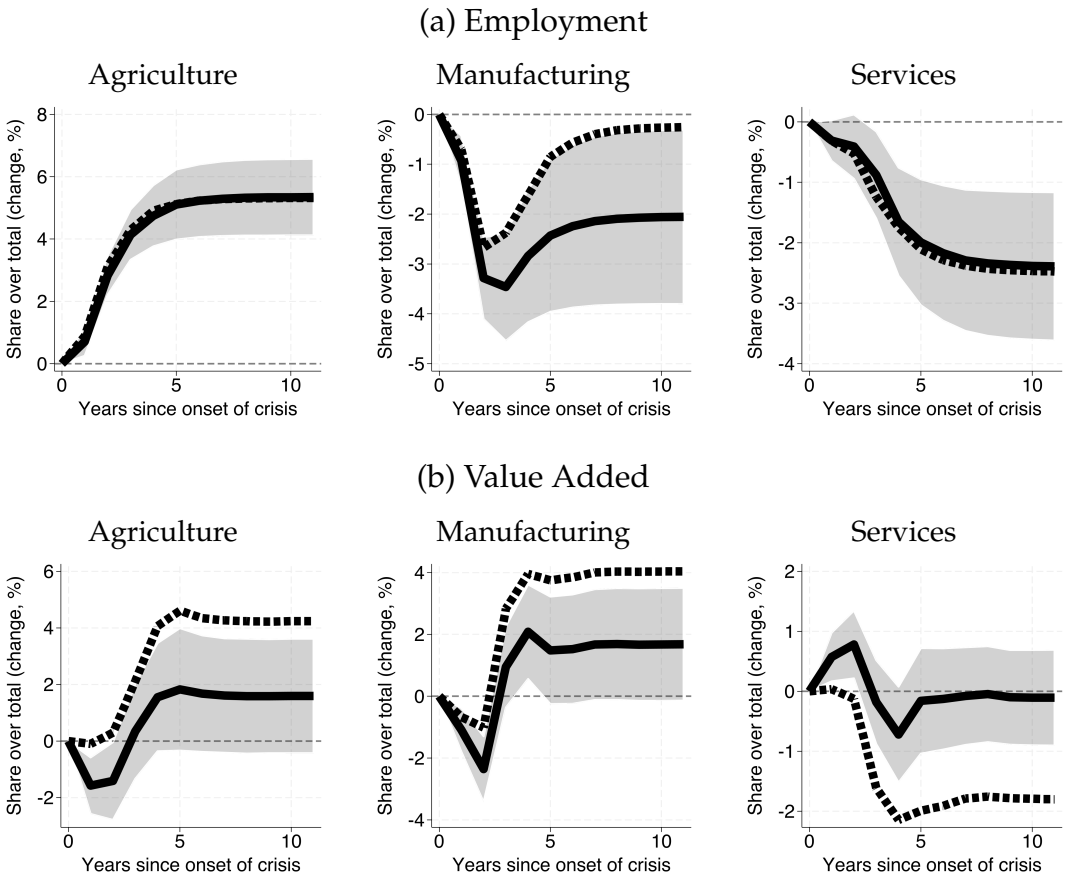

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Crisis episodes are banking and/or sovereign default episodes with large devaluations. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.13:** Sectoral Reallocation during Crisis: Large Growth Reversal



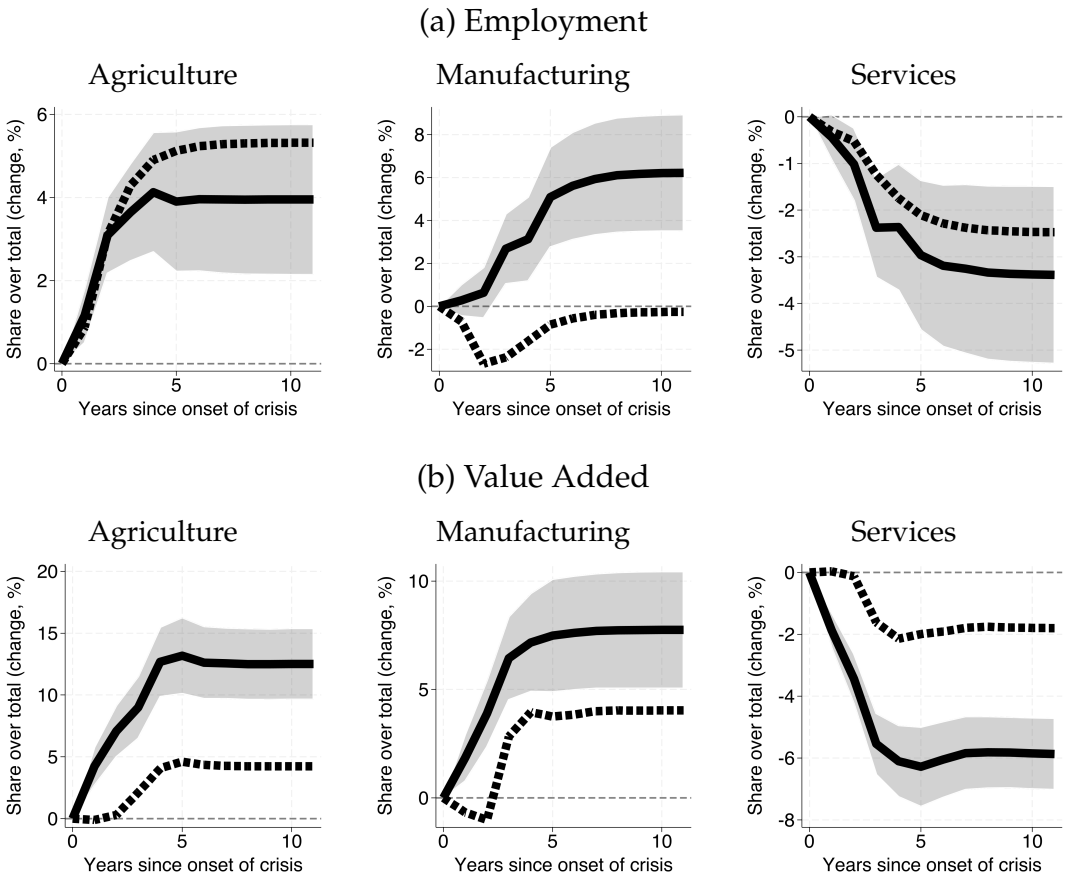

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Crisis episodes are banking and/or sovereign default episodes with large growth reversals. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.14:** Sectoral Reallocation during Crisis: Banking Crisis



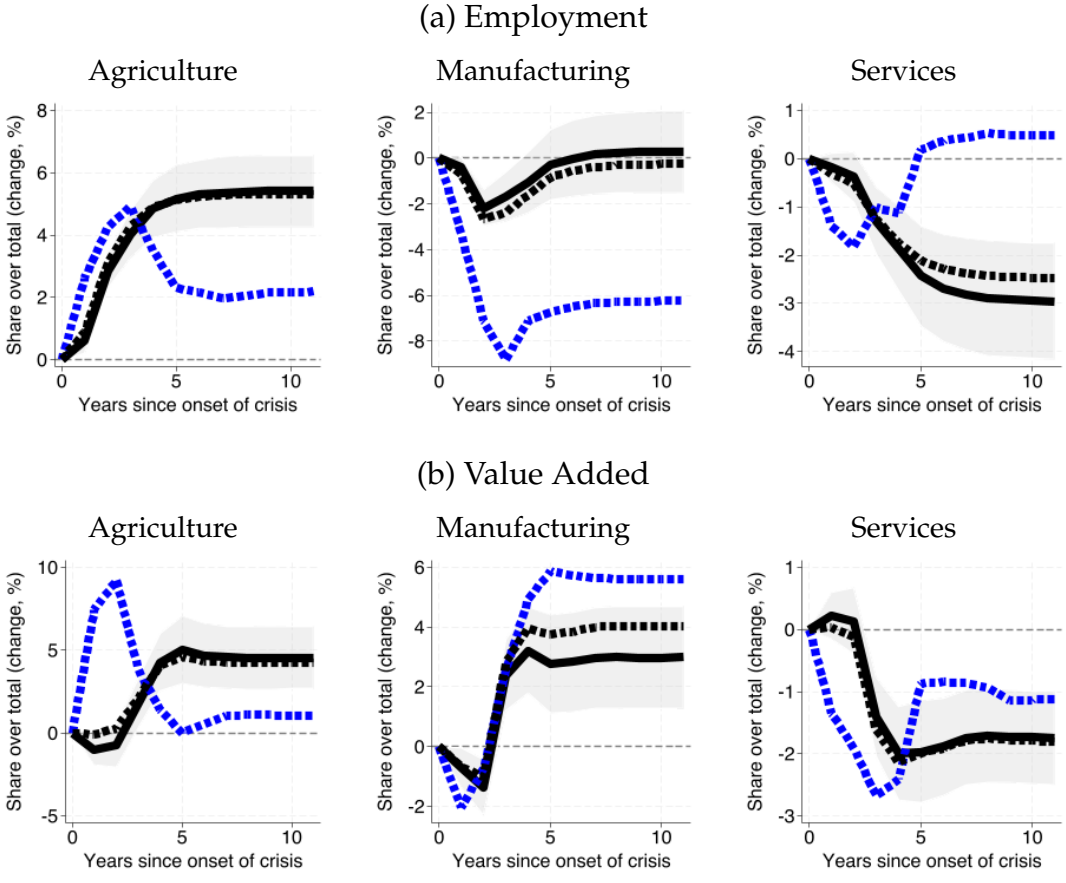

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Crisis episodes are banking crisis. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.15:** Sectoral Reallocation during Crisis: Sovereign Default



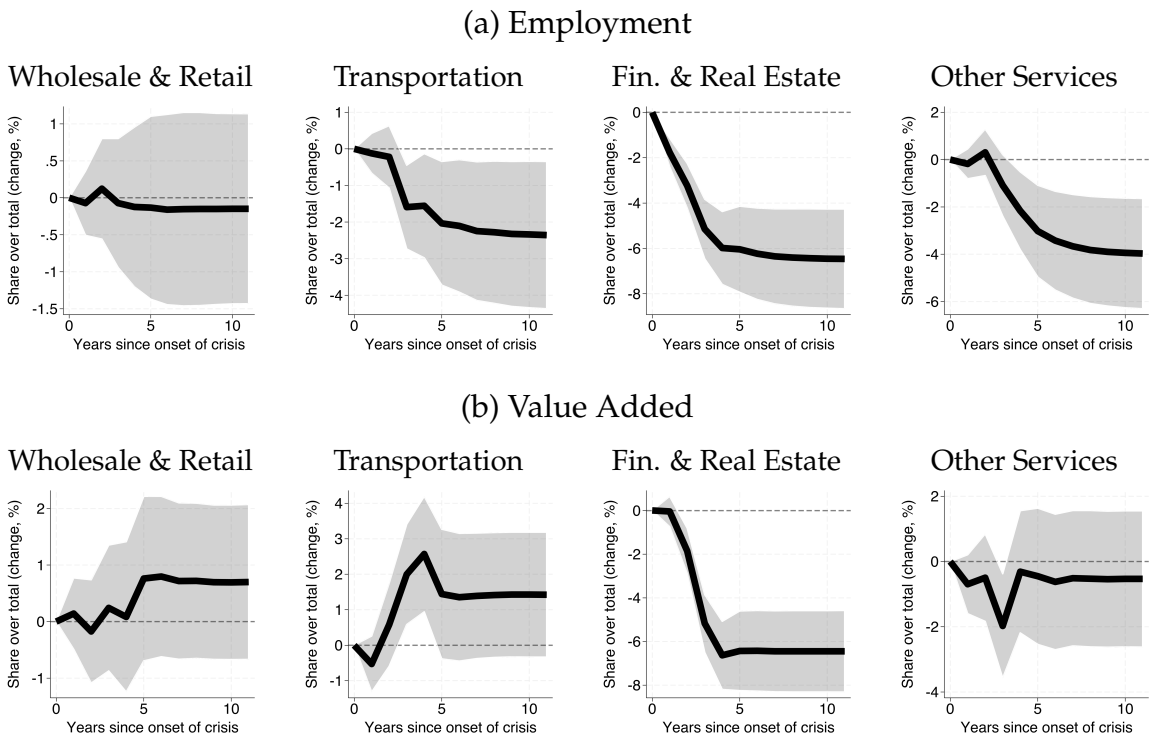

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Crisis episodes are sovereign default episodes. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.16:** Sectoral Reallocation during Crisis without Trade Liberalization



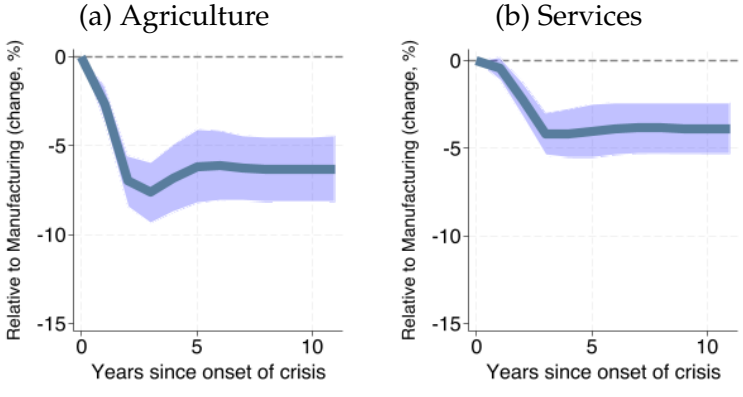

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The black dashed line indicates the baseline crisis episodes, the solid black line represents those not followed by a trade liberalization, and the blue dashed line represents those followed by a trade liberalization. The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.17:** Sectoral Reallocation during Crisis: Disaggregate Service Sectors



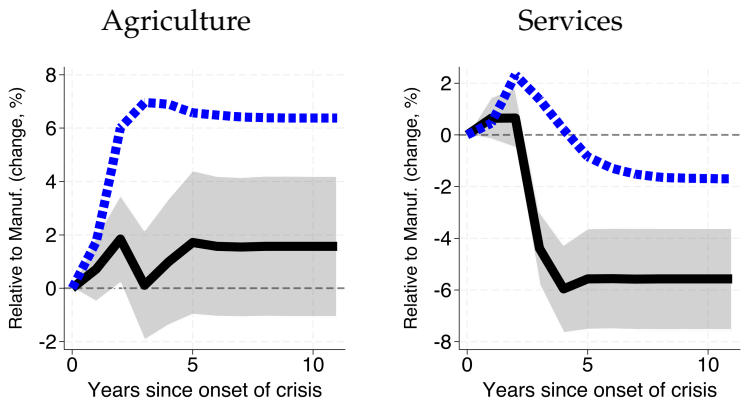

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.18:** Sectoral Prices Dynamics during Crisis: Prices Relative to Manufacturing



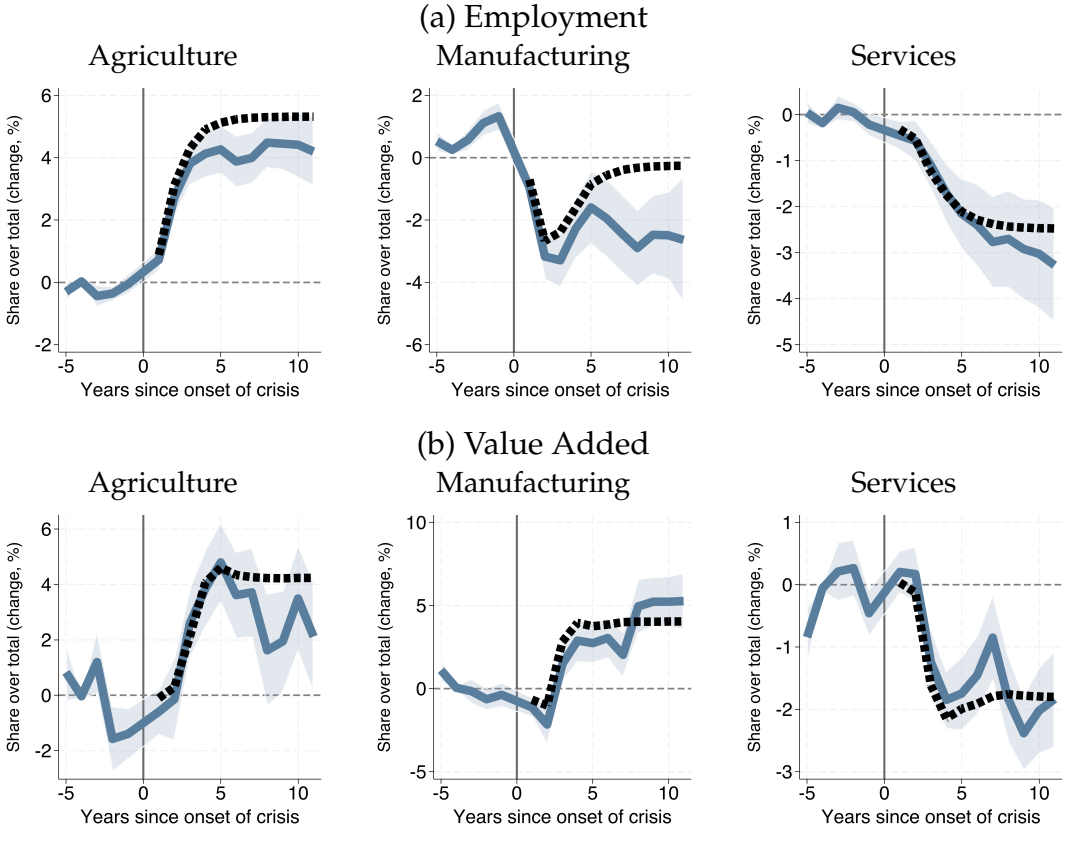

*Notes*: The Figure shows the IRF of the sectoral prices, relative to the manufacturing sector prices, estimated using the model (2). The shadow indicates the one standard deviation error band computed from 1,000 Monte Carlo simulations using the variance-covariance matrix of the estimated coefficients and their asymptotically normal distribution. We fix $H = J = 4$ for our baseline estimates. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.19:** Sectoral Reallocation during Crisis: Relative to Manufacturing



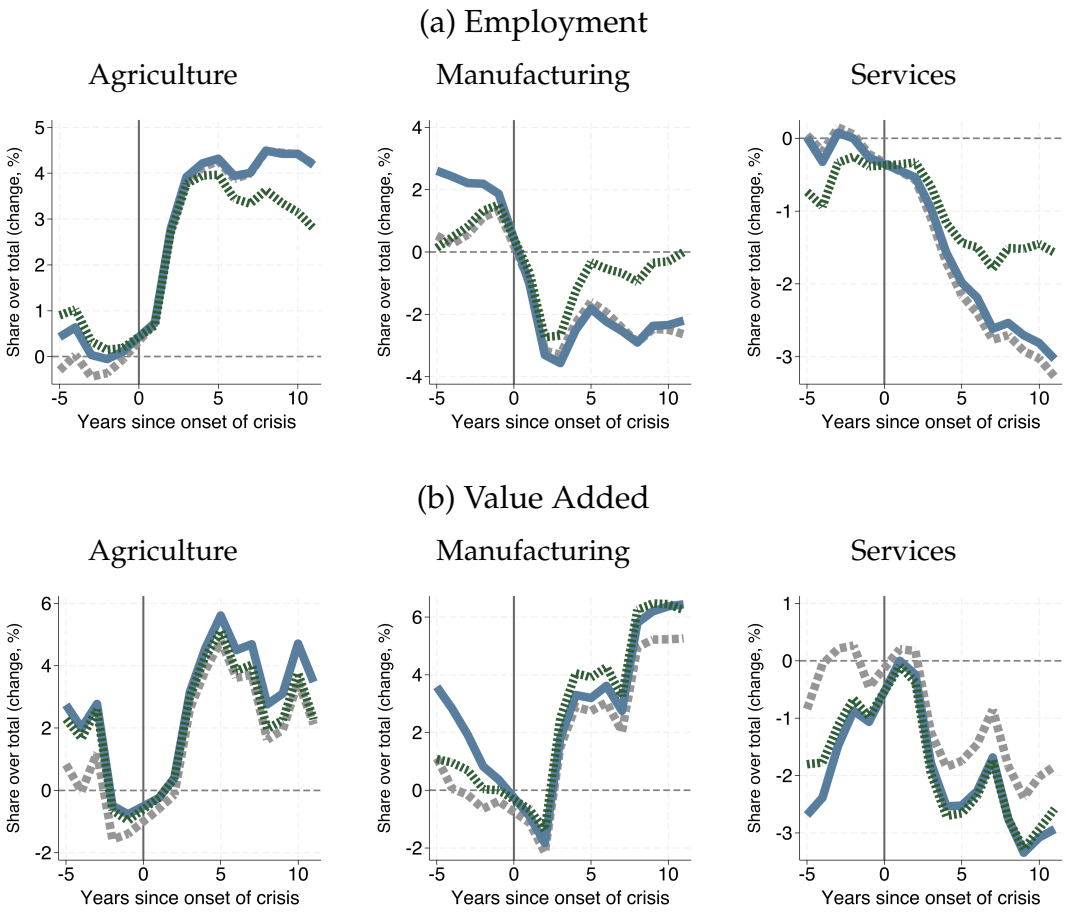

*Notes*: The figure shows the impulse response of the value added share (solid line) and the employment share (dashed line) relative to manufacturing, estimated with Equation (2). Manufacturing is omitted because it is zero by construction. Shaded areas represent one standard deviation error band of the value added share.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.20:** Sectoral Reallocation during Crisis: Local Projections



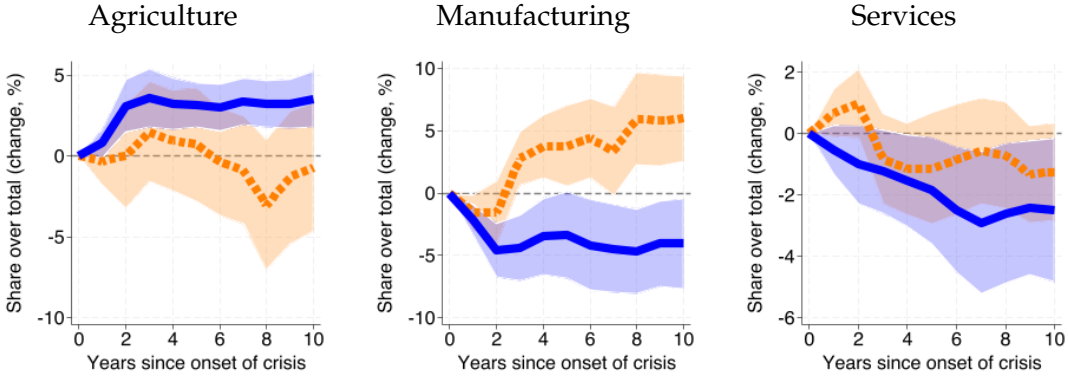

*Notes*: The Figure shows the IRF of the employment share (panel a) and value added shares (panel b) estimated using local projections (solid line) and using the baseline empirical model (dashed line). We estimate $\ln s^k_{it+h} - \ln s^k_{it} = \alpha^{kh}_i + \beta^{kh} D_{it+1} + \gamma^{kh} \mathbf{Z}_{it} + \varepsilon^{kh}_{it+h}$, where $s^k_{it}$ is the employment/value-added share at period $t$ for country $i$ and sector $k$, $D_{it+1}$ indicates the first period of the crisis, $\alpha^{kh}_i$ is a country fixed effect, and $\mathbf{Z}_{it}$ are control variables. We control by the level of income, the sectoral share, and pre-crisis share growth. The coefficient $\beta^{kh}$ calculates the dynamic of the sector $h$ periods after the crisis for sector $k$. We estimate for $h \in [-5, 10]$. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.21:** Sectoral Reallocation during Crisis: Pre-Trends



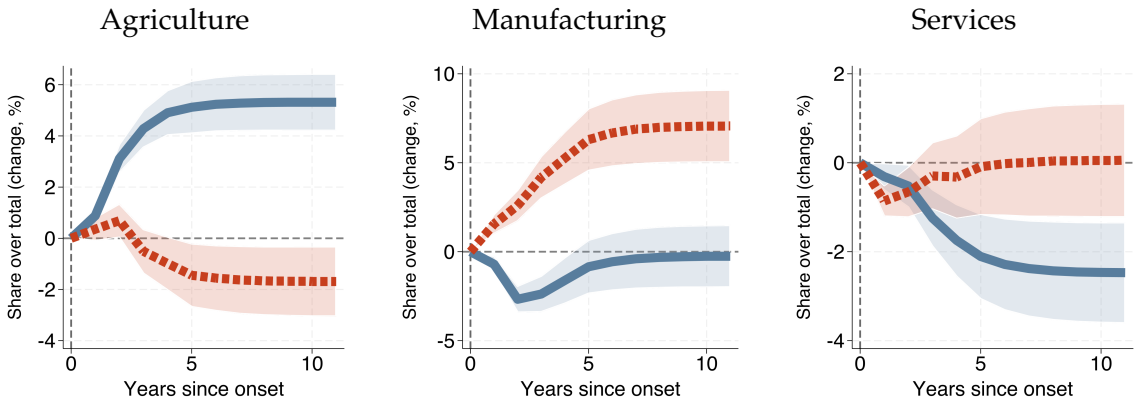

*Notes*: The figure shows the local projection estimates of equation (3) under three sets of controls: our baseline controls (grey dashed line), controls dated strictly before the pre-crisis window (blue solid line), and the latter plus country-specific linear trends (green dashed line). The vertical line is the onset of the crisis.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.22:** Sectoral Reallocation during Crisis: LP-IPW



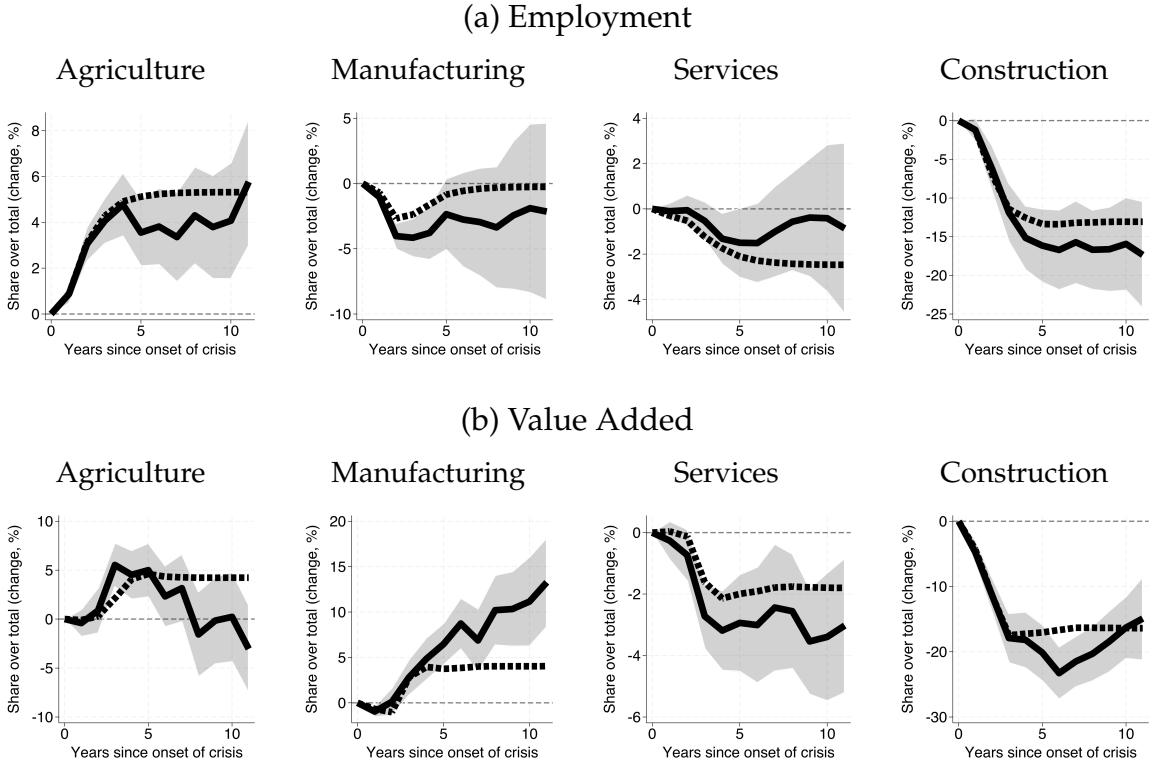

*Notes*: The Figure shows the IRF of the employment share (solid line) and value added shares (dashed) estimated using the model (3) weighted by the inverse propensity score, as explained in the text. The shadow indicates the 90% error interval. Further details regarding the data are in Section 2.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

**Figure A.23:** Crises and Growth Accelerations




*Notes*: The figure compares the impulse response of the employment shares to a crisis episode (solid line) with the response to a growth acceleration episode (dashed line), both estimated with Equation (2). Growth accelerations are identified following Hausmann *et al.* (2005). Shaded areas represent one standard deviation error bands.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

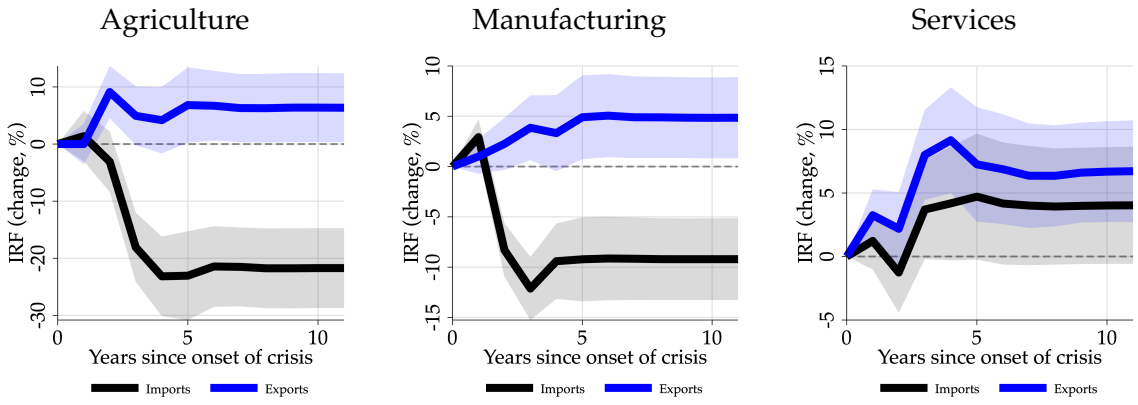
**Figure A.24:** Sectoral Reallocation during Crisis: Construction Booms




*Notes*: The figure restricts the sample to episodes with a large construction run-up and compares those followed by a crisis with those that are not. The solid line is this boom-matched estimate and the dashed line is our baseline estimate. We define a construction boom as an increase of the construction value-added share over the full total of at least 9% over five years, the 60th percentile of the distribution. Shaded areas represent one standard deviation error bands.
*Data sources*: crisis dates and sectoral data sources are described in Section 2.1.

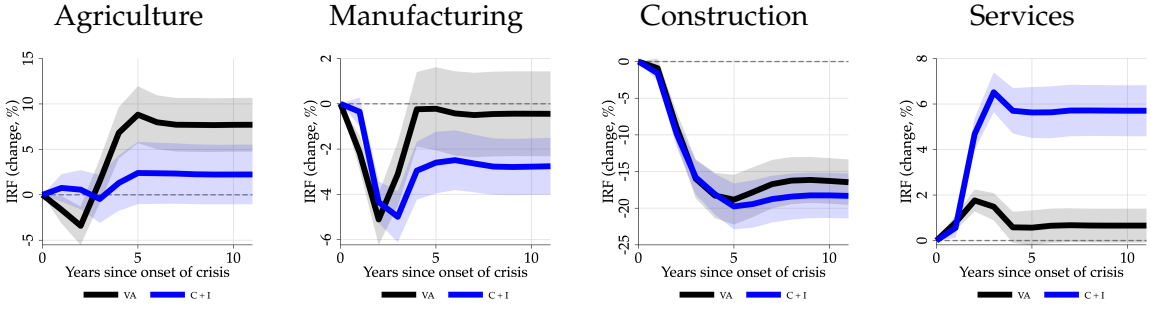
## A.1 Sectoral Net Exports and Domestic Absorption

**Figure A.25:** Imports and Exports Over Value Added




*Notes*: The figure shows the impulse response of exports and imports for final use over value added to a crisis episode, by sector. Shaded areas represent 90% confidence intervals.
*Data source*: WIOD.

**Figure A.26:** Value Added and Domestic Absorption Shares

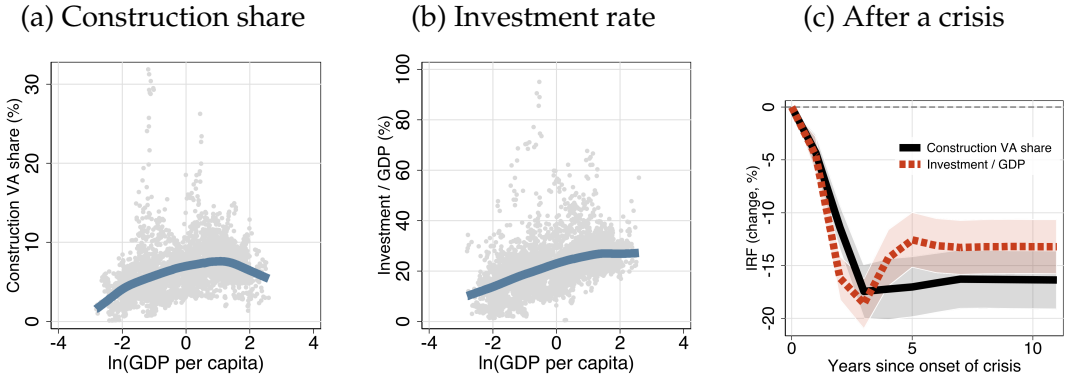



*Notes*: The figure shows the impulse response of sectoral domestic absorption (consumption and investment) shares and value added shares to a crisis episode, by sector. Shaded areas represent 90% confidence intervals.
*Data source*: WIOD.

## A.2 Construction as the Investment Sector

Most of construction output is absorbed as investment rather than consumption. In the input-output data, 71% of construction gross output is used for gross fixed capital formation, compared with 10% in manufacturing, 4% in services, and 2% in agriculture. Construction also supplies about half of all gross fixed capital formation. Figure A.27 shows that the construction value-added share and the investment rate have a similar shape both across the development spectrum and after crises. For this reason we treat construction as the investment sector and exclude it from the consumption sectors.

**Figure A.27:** Construction and Investment



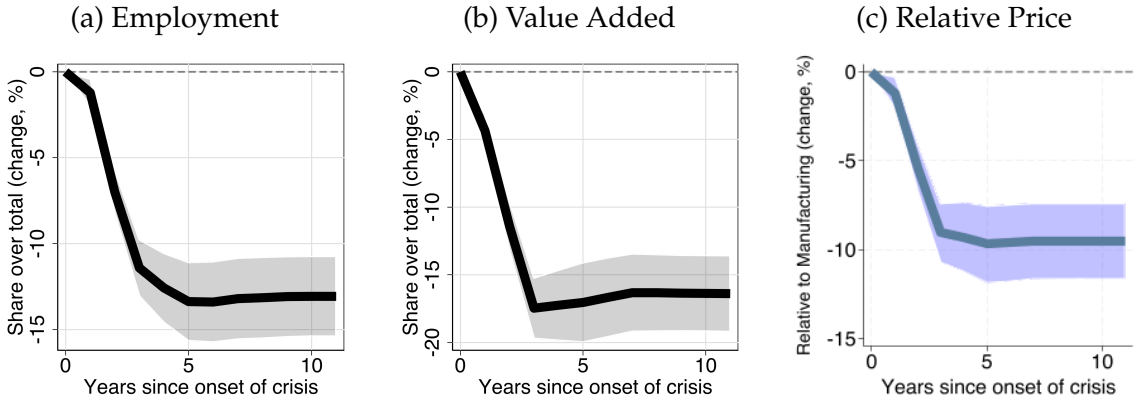

*Notes*: Panels (a) and (b) show the construction value-added share and investment over GDP against log GDP per capita PPP, with the locally weighted smoothing of the observations. Panel (c) shows the impulse response of both series to a crisis episode; the solid line is the construction value-added share and the dashed line is investment over GDP. Shaded areas represent one standard deviation error bands. *Data source*: Penn World Tables, World Input-Output Database, and sectoral data sources described in Section 2.1.

Figure A.28 reports the baseline reallocation estimates for construction, treating it as an additional sector. Its employment and value-added shares decline persistently by about 13% and 16% after a crisis.

## A.3 Baseline and WIOD Samples

The input-output data (WIOD) used to measure the trade channel covers 39 of our 79 baseline countries, and is tilted toward developed economies. Figure A.29 compares the estimated reallocation in the two samples. The patterns are qualitatively similar in both samples: employment and value added reallocate toward agriculture relative to manufacturing, while the reallocation of services is negative or close to zero. The reallocation toward agriculture is larger in the input-output sample, consistent with its different composition. Except for agriculture employment, the differences between the

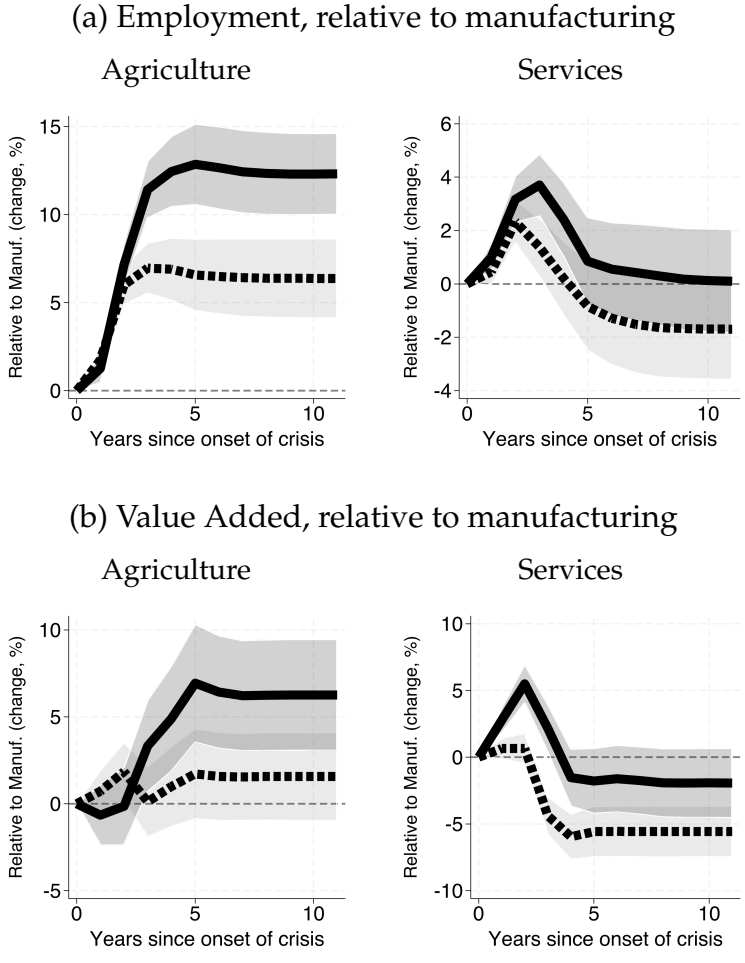
**Figure A.28:** Construction Reallocation during Crisis




*Notes*: The figure shows the impulse response of the construction employment and value-added shares, and of the construction price relative to manufacturing, to a crisis episode, estimated with Equation (2). Shares are computed over the total including construction. Shaded areas represent one standard deviation error bands.

two samples are within the error bands.

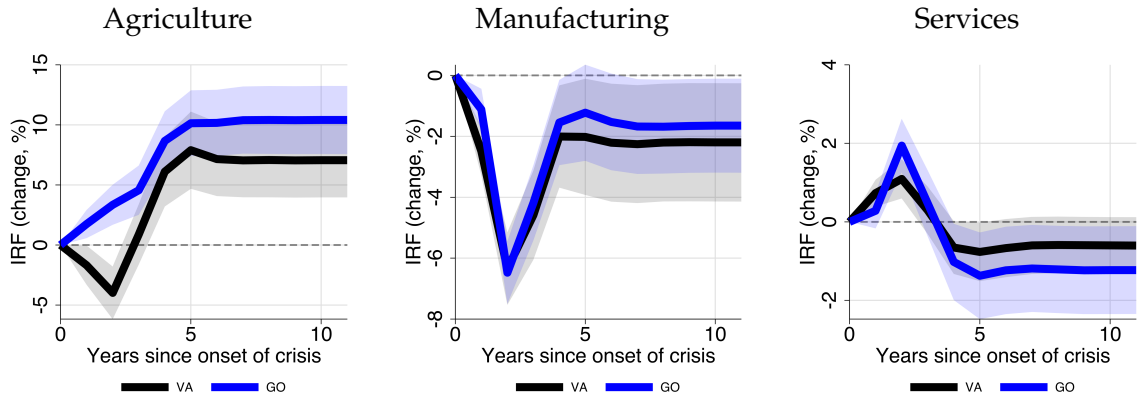
**Figure A.29:** Reallocation in the Baseline and Input-Output Samples




*Notes*: The figure shows the impulse response to a crisis episode of the employment and value-added shares relative to manufacturing. The solid line is the input-output sample and the dashed line is the baseline sample, each with its one standard deviation error band.

**Value Added and Gross Output.** The baseline model abstracts from intermediate inputs, so production linkages would matter for the reallocation we measure if value added and gross output moved differently after a crisis. Figure A.30 compares the response of each sector's value-added and gross-output shares in the input-output sample. The two track each other closely, with overlapping error bands: the agriculture share rises in both, by about 7% in value added and 10% in gross output, while the service share is close to zero in both after an initial increase. To a first order, linkages therefore do not change the importance of the channels we measure.

**Figure A.30:** Value Added and Gross Output Reallocation




*Notes*: Impulse response to a crisis episode of each sector's share of value added (black) and of gross output (blue), in the input-output sample, with one standard deviation error bands.

## A.4 Reallocation Channels: Dynamics

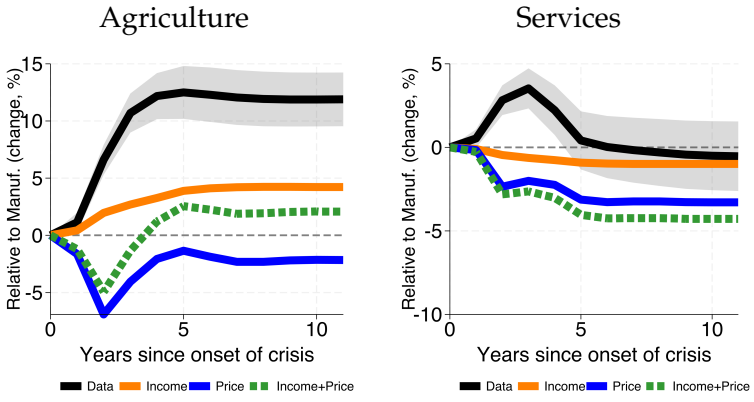
Figure A.31 reports the dynamics behind the contributions summarized in Table 3, on the WIOD sample.

## A.5 Additional Decomposition Results

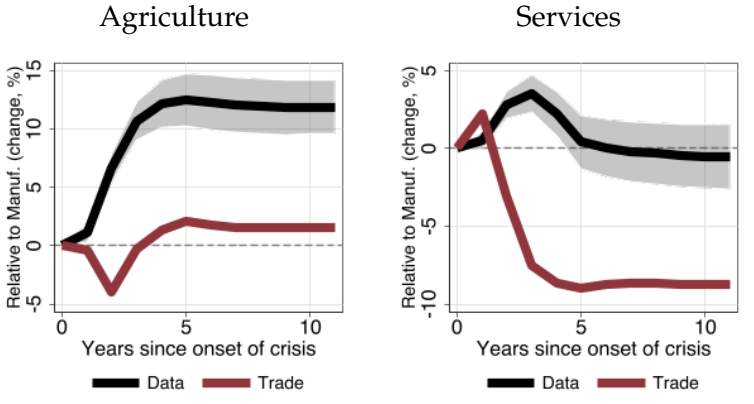
Table A.5 and Table A.6 report the decomposition by level of development and by type of crisis, discussed in Section 5.3.

**Figure A.31:** Reallocation Channels

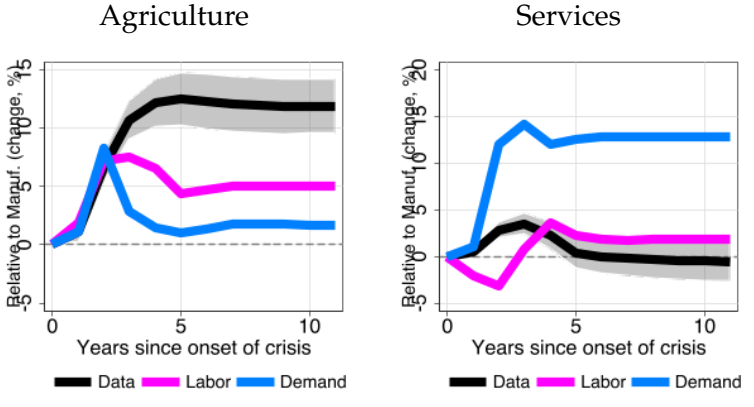
(a) Income and price effects




(b) Trade reallocation




(c) Labor and demand distortions




*Notes*: Simulated employment relative to manufacturing, by channel, on the WIOD sample. The black line and shaded area are the estimated response in the data and its 90% confidence interval. Panel (a) shows the income effect, the price effect, and their sum, which is the prediction of the model without distortions and without trade.

# B Model Appendix

**Table A.5:** Contributions by Level of Development

| | A. Developed | | B. Emerging | |
|---|---|---|---|---|
| | Agriculture | Services | Agriculture | Services |
| Data, $\Delta \log (L_i / L_{\text{MAN}})$ | +17.9 | +1.8 | +2.2 | −3.0 |
| Income effect | +6.4 | −1.5 | +2.8 | −0.7 |
| Price effect | −1.0 | −2.8 | −3.9 | −1.9 |
| Labor distortions | +3.9 | +0.8 | +7.4 | +8.6 |
| Demand distortions | +8.6 | +4.2 | −1.7 | −6.6 |

*Notes*: As in Table 3, Panel (b). Whole sample, so sectoral trade is not measured and the trade channel is absorbed into the distortions. Contributions in percent, averaged over years +8 to +11 after the onset.

**Table A.6:** Contributions by Type of Crisis

| | Banking | Sovereign debt | Large devaluation | Large reversal |
|---|---|---|---|---|
| *A. Agriculture* | | | | |
| Data, $\Delta \log (L_i / L_{\text{MAN}})$ | +8.2 | −1.4 | +3.3 | +10.4 |
| Income effect | +3.4 | +3.8 | +3.6 | +5.3 |
| Price effect | −3.4 | −1.1 | −2.7 | −2.7 |
| Labor distortions | +7.3 | −2.8 | +6.4 | +6.0 |
| Demand distortions | +1.4 | +2.3 | −1.0 | +1.7 |
| *B. Services* | | | | |
| Data, $\Delta \log (L_i / L_{\text{MAN}})$ | +0.3 | −9.0 | −2.6 | −0.2 |
| Income effect | −0.8 | −0.9 | −0.9 | −1.3 |
| Price effect | −1.5 | −2.3 | −1.2 | −2.8 |
| Labor distortions | +4.4 | +7.0 | +9.3 | +8.0 |
| Demand distortions | −0.3 | −10.5 | −7.1 | −2.9 |

*Notes*: As in Table 3, Panel (b). Whole sample, so the trade channel is absorbed into the distortions. Contributions in percent, averaged over years +8 to +11 after the onset.

## B.1 Baseline Model Derivation

**Proposition 1** (Reallocation in Equilibrium)**.** *Consider a competitive equilibrium of the model in Section 4, with capital intensities constant over time. Then the change in relative employment across sectors i and j satisfies*

$$\Delta \log \left( \frac{L_{it}}{L_{jt}} \right) = (\varepsilon_i - \varepsilon_j)(1-\sigma) \Delta \log c_t + (1-\sigma) \Delta \log \left( \frac{p_{cit}}{p_{cjt}} \right) + \Delta \log \left( \frac{p_{Hit} Y_{it} / p_{cit} c_{it}}{p_{Hjt} Y_{jt} / p_{cjt} c_{jt}} \right) - \Delta \log \Omega^L_{ijt} - \Delta \log \Omega^D_{ijt},$$

**Table A.7:** Contributions within Services

| | WRT | Transportation | FIRE | Other |
|---|---|---|---|---|
| Data, $\Delta \log (L_i / L_{\text{MAN}})$ | $+1.1$ | $-1.5$ | $-4.9$ | $-3.0$ |
| Income effect | $-2.4$ | $-1.7$ | $-4.5$ | $-0.7$ |
| Price effect | $-1.1$ | $-2.2$ | $-3.1$ | $-4.0$ |
| Labor distortions | $+4.3$ | $+1.8$ | $+5.6$ | $+3.8$ |
| Demand distortions | $+0.5$ | $+1.8$ | $-1.5$ | $+0.3$ |

*Notes*: As in Table 3, Panel (b). Whole sample, so sectoral trade is not measured and the trade channel is absorbed into the distortions. Contributions in percent, averaged over years $+8$ to $+11$ after the onset. Income elasticities are from Table XII of Comin *et al.* (2021). WRT = Wholesale & Retail; FIRE = Finance & Real Estate.

*where* $\Omega^L_{ijt} \equiv \tau^w_{it} / \tau^w_{jt}$ *and* $\Omega^D_{ijt} \equiv \frac{\gamma_{jt}}{\gamma_{it}} \left( \frac{\tau^c_{jt}}{\tau^c_{it}} \right)^{-\sigma}$.

*Proof.* We first solve the household's intratemporal problem for the demand system, and then combine it with the firms' labor first order condition and sectoral market clearing.

Within a period the household minimizes consumption expenditure subject to the aggregator (5), which written implicitly reads $\sum_{i \in \mathcal{I}} \gamma_{it}^{1/\sigma} \left( c_{it} / c_t^{\varepsilon_i} \right)^{(\sigma-1)/\sigma} = 1$. The problem is

$$\min_{\{c_{it}\}} \sum_{i \in \mathcal{I}} \tau^c_{it} p_{cit} c_{it} \quad \text{subject to} \quad \sum_{i \in \mathcal{I}} \gamma_{it}^{\frac{1}{\sigma}} \left( \frac{c_{it}}{c_t^{\varepsilon_i}} \right)^{\frac{\sigma-1}{\sigma}} = 1,$$

with Lagrangian

$$\mathcal{L} = \sum_{i \in \mathcal{I}} \tau^c_{it} p_{cit} c_{it} + \lambda \left[ 1 - \sum_{i \in \mathcal{I}} \gamma_{it}^{\frac{1}{\sigma}} \left( \frac{c_{it}}{c_t^{\varepsilon_i}} \right)^{\frac{\sigma-1}{\sigma}} \right].$$

The first order condition with respect to $c_{it}$ is

$$\tau^c_{it} p_{cit} = \lambda \frac{\sigma - 1}{\sigma} \frac{\gamma_{it}^{\frac{1}{\sigma}}}{c_t^{\varepsilon_i}} \left( \frac{c_{it}}{c_t^{\varepsilon_i}} \right)^{\frac{\sigma-1}{\sigma} - 1}$$

$$\tau^c_{it} p_{cit} c_{it} = \lambda \frac{\sigma - 1}{\sigma} \gamma_{it}^{\frac{1}{\sigma}} \left( \frac{c_{it}}{c_t^{\varepsilon_i}} \right)^{\frac{\sigma-1}{\sigma}}.$$

Summing across sectors and using the constraint gives total expenditure,

$$E_t = \sum_{i \in \mathcal{I}} \tau^c_{it} p_{cit} c_{it} = \lambda \frac{\sigma - 1}{\sigma},$$

so that each sector's expenditure share is $\tau^c_{it} p_{cit} c_{it} / E_t = \gamma_{it}^{1/\sigma} \left( c_{it} / c_t^{\varepsilon_i} \right)^{(\sigma-1)/\sigma}$. Rearranging yields the demand for good $i$ in (10),

$$c_{it} = \gamma_{it} \left( \frac{\tau^c_{it} p_{cit}}{E_t} \right)^{-\sigma} c_t^{\varepsilon_i (1-\sigma)},$$

and substituting it back into the definition of total expenditure gives the expenditure function

$$E_t = \left( \sum_{i \in \mathcal{I}} \gamma_{it} \left( \tau^c_{it} p_{cit} \right)^{1-\sigma} c_t^{\varepsilon_i (1-\sigma)} \right)^{\frac{1}{1-\sigma}}.$$

Taking the ratio of the demands for any two sectors, relative consumption expenditure is

$$\frac{p_{cit} c_{it}}{p_{cjt} c_{jt}} = \left( \frac{p_{cit}}{p_{cjt}} \right)^{1-\sigma} \left( \frac{\tau^c_{it}}{\tau^c_{jt}} \right)^{-\sigma} \frac{\gamma_{it}}{\gamma_{jt}} c_t^{(1-\sigma)(\varepsilon_i - \varepsilon_j)}. \tag{28}$$

From the firms' labor first order condition (13) in sectors $i$ and $j$, relative employment is

$$\frac{L_{it}}{L_{jt}} = \frac{(1-\alpha_i)}{(1-\alpha_j)} \frac{p_{Hit} Y_{it}}{p_{Hjt} Y_{jt}} \frac{\tau^w_{jt}}{\tau^w_{it}}.$$

In the open economy sectoral value added and sectoral consumption expenditure no longer coincide: by sectoral market clearing (18) part of domestic output is exported, and part of domestic consumption is imported. Writing relative value added as relative consumption expenditure times the ratio of value added to consumption expenditure within each sector,

$$\frac{p_{Hit} Y_{it}}{p_{Hjt} Y_{jt}} = \frac{p_{cit} c_{it}}{p_{cjt} c_{jt}} \frac{p_{Hit} Y_{it} / p_{cit} c_{it}}{p_{Hjt} Y_{jt} / p_{cjt} c_{jt}},$$

where the second factor equals one when each sector's output is consumed entirely at home. Substituting relative consumption expenditure (28), taking logs and time differences, and holding capital intensities constant over time gives the expression in the proposition. □

## B.2 Inference of Prices and Distortions

This appendix derives the three equilibrium conditions used in Section 5.1 to express the unobserved components of Proposition 1 as functions of observables and parameters.

**Relative consumption prices.** Sectoral consumption price indices are not as broadly available in the data as output prices. The equilibrium condition for relative consumption prices links them to relative output prices and the domestic consumption share within each sector, where $\nu_i$ is the elasticity of substitution between home and foreign varieties in sector $i$:

$$\Delta \log \left( \frac{p_{cit}}{p_{cjt}} \right) = \underbrace{\Delta \log \left( \frac{p_{Hit}}{p_{Hjt}} \right)}_{\Delta \text{ relative Y prices}} + \underbrace{\left[ \frac{1}{\nu_i - 1} \Delta \log \left( \frac{p_{Hit} c_{Hit}}{p_{cit} c_{it}} \right) - \frac{1}{\nu_j - 1} \Delta \log \left( \frac{p_{Hjt} c_{Hjt}}{p_{cjt} c_{jt}} \right) \right]}_{\Delta \text{ domestic c share}}.$$

**Labor distortions.** Using the firm's labor first order condition in both sectors, the labor wedge is identified from the gap between value added and employment dynamics: if a sector's share of nominal output grows faster than its employment share, this implies a rising labor wedge in that sector relative to the other,

$$\Delta \log \Omega^L_{ijt} \equiv \Delta \log \left( \tau^w_{it} / \tau^w_{jt} \right) = \Delta \log \left( \frac{p_{Hit} Y_{it}}{p_{Hjt} Y_{jt}} \right) - \Delta \log \left( \frac{L_{it}}{L_{jt}} \right).$$

**Demand distortions.** Finally, demand distortions are recovered as the residual between observed relative consumption expenditure dynamics and what the demand system — given relative prices and aggregate consumption — would predict,

$$\Delta \log \Omega^D_{ijt} = \underbrace{(1-\sigma) \Delta \log \left( \frac{p_{cit}}{p_{cjt}} \right)}_{\text{price effect}} + \underbrace{\left( \varepsilon_i - \varepsilon_j \right) (1-\sigma) \Delta \log c_t}_{\text{income effect}} - \Delta \log \left( \frac{p_{cit} c_{it}}{p_{cjt} c_{jt}} \right).$$

**Relative output prices.** Substituting the firm's first order conditions into the production technology yields relative output prices as a function of input prices, distortions, and model primitives:

$$\frac{p_{Hit}}{p_{Hjt}} = \frac{A_{jt}}{A_{it}} \frac{\left(1-\alpha_j\right)^{1-\alpha_j} \alpha_j^{\alpha_j}}{\left(1-\alpha_i\right)^{1-\alpha_i} \alpha_i^{\alpha_i}} \left( \frac{w_t}{R_t} \right)^{\alpha_j - \alpha_i} \left[ \frac{\left(\tau^w_{it}\right)^{1-\alpha_i} \left(\tau^k_{it}\right)^{\alpha_i}}{\left(\tau^w_{jt}\right)^{1-\alpha_j} \left(\tau^k_{jt}\right)^{\alpha_j}} \right],$$

so that relative prices reflect cross-sector differences in productivity, input intensities, and input wedges. Disentangling productivity from input distortions is generally challenging, even conditional on observing factor prices $\{w_t, R_t\}$ and capital intensities

$\{\alpha_i\}$. In the special case $\alpha_i = \alpha$ for all $i$, however, this simplifies to

$$\frac{p_{Hit}}{p_{Hjt}} = \frac{A_{jt}}{A_{it}} \left( \frac{\tau^k_{it}}{\tau^k_{jt}} \right)^{\alpha} \left( \frac{\tau^w_{it}}{\tau^w_{jt}} \right)^{1-\alpha},$$

so that relative prices are pinned down by relative productivity and input distortions alone.

## B.3 Parameters for the Decomposition

**Table B.8:** Parameters

| | $\sigma$ | $\varepsilon_{\text{MAN}}$ | $\varepsilon_{\text{AGR}}$ | $\varepsilon_{\text{SERV}}$ | $\nu$ |
|---|---|---|---|---|---|
| Value | 0.5 | 1 | 0.11 | 1.21 | 4.14 |

*Notes*: Base sector for income elasticities is manufacturing. Trade elasticity $\nu_i = \nu$ for all $i$.
*Source*: Comin *et al.* (2021); Simonovska and Waugh (2014).

The substitution elasticity and the income elasticities are taken together from the three-sector cross-country estimates of Comin *et al.* (2021), column (2) of their Table III, which includes trade controls.

## B.4 The Constant Growth Path

This appendix proves Proposition 2, taking the conditions of the proposition as given.

*Proof.* Consider a path along which the exchange rate is constant, net foreign assets relative to trend, $\tilde{a}_t = a_t / A_{0t}^{1/(1-\alpha)}$, are constant, and real consumption grows at a constant rate $1 + g^*$. To save notation, let $G \equiv (1 + g_0)^{\frac{1}{1-\alpha}}$, the growth rate of $A_{0t}^{1/(1-\alpha)}$. All distortions are at their long-run value of one and the demand shifters are constant at $\gamma_i$, so the transfer $T_t$ is zero. We show that along this path aggregates grow at $G$, consumption grows at the rate stated in the proposition, and net foreign assets and net exports are zero.

**Interest rate and factor prices.** With $\tilde{a}_t$ constant, the debt-elastic rule gives a constant country rate $r$. With a constant exchange rate and no capital wedge in the investment sector, no-arbitrage between domestic capital and the foreign asset then gives a constant rental rate, $R = r + \delta$. With common capital intensity and no distortions,

the firms' first order conditions imply the same capital-labor ratio in every sector, $K_{it}/L_{it} = \frac{\alpha}{1-\alpha}\frac{w_t}{R}$, and since labor sums to one this ratio equals the aggregate capital stock $K_t$. The capital first order condition in the investment sector, where the price is one, then reads

$$R = \alpha A_{0t} K_t^{\alpha-1}, \qquad \text{so that} \qquad \tilde{K}_t = \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}},$$

and the labor first order condition gives $w_t = (1-\alpha) A_{0t} K_t^{\alpha}$. The capital stock and the wage therefore both grow at $G$.

**Relative prices.** The zero profit condition in sector $i$ gives $p_{Hit} = \frac{1}{A_{it}} \left(\frac{w_t}{1-\alpha}\right)^{1-\alpha} \left(\frac{R}{\alpha}\right)^{\alpha}$. Dividing by the same condition in the investment sector, where the price is one, gives $p_{Hit} = A_{0t}/A_{it}$, which grows at $(1+g_0)/(1+g_i)$. By (17), the price of the foreign variety is $p_{Fit} = e_t p^*_{Fit}$, which with a constant exchange rate grows at the rate of the foreign price, $(1+g_0)/(1+g_i)$ by assumption. Since the prices of both varieties grow at the same rate, the sectoral consumer price index $p_{cit}$ grows at that rate as well.

**Aggregate quantities.** Investment is $x_t = K_{t+1} - (1-\delta)K_t$, so that $\tilde{x}_t = \vartheta \tilde{K}_t$ with $\vartheta \equiv G - (1-\delta)$, and investment also grows at $G$. Firms make zero profits and the transfer is zero, so dividing the budget constraint (8) by $A_{0t}^{1/(1-\alpha)}$ gives

$$\tilde{E}_t + \tilde{x}_t + G\, e\, \tilde{a} = \tilde{w}_t + R\tilde{K}_t + (1+r)\, e\, \tilde{a}.$$

Every term other than $\tilde{E}_t$ is constant, so consumption expenditure grows at $G$ as well.

**Expenditure shares and the growth of consumption.** By the demand system (10), the expenditure share of sector $i$ is $\omega_{it} \equiv p_{cit} c_{it}/E_t = \gamma_i\, p_{cit}^{1-\sigma} E_t^{\sigma-1} c_t^{\varepsilon_i(1-\sigma)}$. Using the growth rates of $p_{cit}$, $E_t$ and $c_t$, the share grows at the constant gross rate

$$1 + \xi_i = \left(\frac{1+g_0}{1+g_i}\right)^{1-\sigma} G^{\sigma-1} (1+g^*)^{\varepsilon_i(1-\sigma)} = \left[\frac{(1+g^*)^{\varepsilon_i}}{(1+g_0)^{\frac{\alpha}{1-\alpha}}(1+g_i)}\right]^{1-\sigma}.$$

Shares lie between zero and one and sum to one, so no share can keep growing, $\xi_i \leq 0$ for every $i$, and at least one share must stay positive, $\xi_i = 0$ for some $i$. With $\sigma < 1$, $\xi_i \leq 0$ is equivalent to

$$1 + g^* \leq \left[(1+g_0)^{\frac{\alpha}{1-\alpha}}(1+g_i)\right]^{\frac{1}{\varepsilon_i}},$$

with equality for at least one sector. Hence $1 + g^*$ equals the minimum of the right-hand side across sectors, which is the expression in the proposition. The sector or sectors attaining the minimum keep a constant expenditure share, while the share of every other sector declines at a constant rate and vanishes.

**Interest rate and net foreign assets.** As the expenditure shares converge, so does the average income elasticity, $\bar{\varepsilon}_{t+1}/\bar{\varepsilon}_t \to 1$. Using $p_{ct} = E_t/c_t$ and the no-arbitrage condition, the Euler equation (9) can be written as

$$\left(\frac{c_{t+1}}{c_t}\right)^{\theta-1} \frac{\bar{\varepsilon}_{t+1}}{\bar{\varepsilon}_t} \frac{E_{t+1}}{E_t} = \beta\,(1 + r_{t+1})\,\frac{e_{t+1}}{e_t},$$

which along the path reads $(1 + g^*)^{\theta-1} G = \beta(1 + r)$. Under the world interest rate in the proposition, $\beta(1 + r^*) = G(1 + g^*)^{\theta-1}$, this requires $r = r^*$. Since $\psi > 0$, the debt-elastic rule delivers $r = r^*$ only at $\tilde{a} = \bar{a} = 0$, and the detrended country budget constraint (24) then gives $\widetilde{NX} = [G - (1 + r^*)]\,\tilde{a} = 0$. Net foreign assets and net exports are therefore zero along the path.

**Capital-labor ratio and levels.** With $r = r^*$ the rental rate is $R = r^* + \delta$, so the capital-labor ratio, detrended by $A_{0t}^{1/(1-\alpha)}$, is

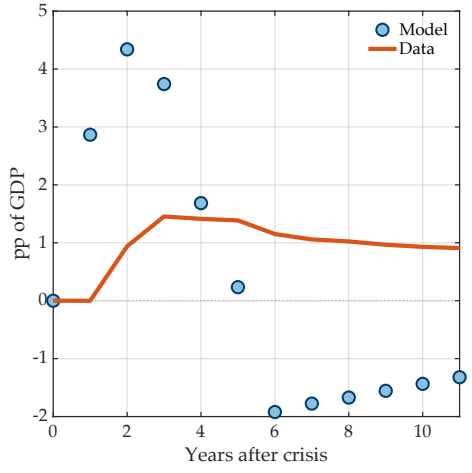
$$\kappa^* = \tilde{K} = \left(\frac{\alpha}{r^* + \delta}\right)^{\frac{1}{1-\alpha}}.$$

The levels of the other aggregates follow. Investment is $\tilde{x} = \vartheta\kappa^*$, and since $\tilde{w} + R\tilde{K} = (\kappa^*)^\alpha$ and net foreign assets are zero, the budget constraint gives consumption expenditure $\tilde{E} = (\kappa^*)^\alpha - \vartheta\kappa^*$. The labor employed in the investment sector is $L_0 = \tilde{x}/(\kappa^*)^\alpha = \vartheta\alpha/(r^* + \delta)$, which lies between zero and one, and expenditure is positive, as long as $\vartheta\alpha < r^* + \delta$. □

## B.5 Untargeted Predictions of the Crisis Experiment

Net exports is not among the seven series the crisis shocks are chosen to fit, so its post-crisis path is a prediction of the model rather than a target. Figure B.32 compares it with the estimated response.

**Figure B.32:** Net Exports after a Crisis




*Notes*: Net exports by years since the onset of the crisis, as a deviation from the no-crisis path. Markers are the model and the line is the estimated response of Section 3 with ±1 standard error bands. The crisis hits at ln GDP per capita of 10. Net exports is not targeted in the calibration of Section 6.3.

## B.6 The Same Shock at Different Stages: One Year After the Crisis

Table B.9 repeats the exercise of Table 8 one year after onset.

**Table B.9:** The Same Shock at Different Stages of Development, One Year After the Crisis

| | VA AGR / MAN | | VA SERV / MAN | |
|---|---|---|---|---|
| Crisis in the: | poorer | richer | poorer | richer |
| The crisis (all shocks) | +4.3 | −1.6 | +0.6 | +3.6 |
| without AGR relative TFP | −1.8 | +0.4 | −4.0 | +2.2 |
| without SERV relative TFP | +5.2 | −1.4 | +2.0 | +2.7 |

*Notes*: Percent deviation of the value added share relative to manufacturing from the no-crisis path, one year after onset. The same identified change in fundamentals is applied to an economy at ln GDP per capita of about 7.2 and to one at about 10.0. Each row below the first re-solves the model with that fundamental held at its no-crisis path.

## B.7 Non-homothetic CES with Stone-Geary Demand System

In this section, we discuss the demand system with non-homothetic CES preferences and heterogeneous subsistence levels of consumption across goods (Stone-Geary). The consumption aggregator is implicitly defined by

$$\left[\sum_{i\in\mathcal{I}} \gamma_{it}^{\frac{1}{\sigma}} \left(\frac{c_{it}-\kappa_i}{c_t^{\varepsilon_i}}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = 1,$$

where $\kappa_i \geq 0$ denotes the subsistence level of consumption for good $i$. Under this specification, relative expenditure is given by

$$\frac{p_{it}c_{it}}{p_{jt}c_{jt}} = \frac{\left(1-\frac{\kappa_j}{c_{jt}}\right)}{\left(1-\frac{\kappa_i}{c_{it}}\right)} \frac{\gamma_{it}}{\gamma_{jt}} \left(\frac{p_i}{p_j}\right)^{1-\sigma} \left(\frac{\tau_{it}^c}{\tau_{jt}^c}\right)^{-\sigma} c_t^{\left(\varepsilon_i-\varepsilon_j\right)(1-\sigma)},$$

which introduces an additional term—relative to the standard non-homothetic CES system—that depends on how close consumption is to its subsistence level.

To build intuition on how this term influences reallocation, assume relative prices, consumption wedges, and demand shifters are fixed; let $\varepsilon_i = \varepsilon_j$ and $\kappa_j = 0$. Then the change in relative expenditure is

$$\mathrm{d}\ln\left(\frac{p_{it}c_{it}}{p_{jt}c_{jt}}\right) = \mathrm{d}\ln c_{it} - \mathrm{d}\ln\left(c_{it}-\kappa_i\right),$$

and applying a log-linear approximation yields

$$\mathrm{d}\ln\left(\frac{p_{it}c_{it}}{p_{jt}c_{jt}}\right) \approx -\left(\frac{\kappa_i}{c_{it}-\kappa_i}\right)\mathrm{d}\ln c_{it}.$$

Now suppose $i$ and $j$ are the only two sectors in the economy and that aggregate consumption evolves as $\mathrm{d}\ln c_t \approx \omega_i \mathrm{d}\ln c_{it} + (1-\omega_i)\mathrm{d}\ln c_{jt}$. Using the expression above, we obtain

$$\mathrm{d}\ln c_t \approx \left[\omega_i + (1-\omega_i)\left(1+\frac{\kappa_i}{c_{it}-\kappa_i}\right)\right]\mathrm{d}\ln c_{it},$$

which implies that a contraction in aggregate consumption reallocates disproportionately more resources toward sector $i$—the sector with stronger non-homotheticities—the

closer its consumption level is to subsistence (e.g., in less developed economies).

Thus, in this simple example, the model predicts that during crises, when consumption contracts sharply, there should be stronger reallocation toward subsistence-intensive sectors, such as agriculture, in poorer economies. However, our empirical findings suggest the opposite (see Figure A.9). We therefore abstract from this source of non-homotheticity in our baseline demand system.

## B.8 Production Linkages

In this section, we extend the model in Section 4 to allow for production linkages across sectors. We assume that gross output is produced with technology

$$Y_{it} = A_{it} K_{it}^{\alpha_i} L_{it}^{\nu_i} X_{it}^{1-\nu_i-\alpha_i},$$

where $X_{it}$ is the intermediate input aggregator, which we assume to be Cobb-Douglas $X_{it} = \prod_{s\in\mathcal{I}} X_{sit}^{\gamma_{si}}$ with $\gamma_{si}$ is the elasticity of sector $s$ to sector $i$ intermediate input aggregator and $X_{sit}$ is the amount of good $s$ used by firms in sector $i$.

$$\pi_{it} = p_{it} Y_{it} - \tau_{it}^{w} w_t L_{it} - \tau_{it}^{k} R_t K_{it} - p_{it}^{x} X_{it},$$

then the price aggregator $p_{it}^{x} = \prod_{s=1}^{N} p_{st}^{\gamma_{si}}$. Using the optimal conditions we can find the price of good $i$ as

$$p_{it} = \chi\left(A_{it}, \tau_{it}^{w}, \tau_{it}^{k}; w_t, R_t, \alpha_i, \nu_i\right) \left(p_{it}^{x}\right)^{1-\nu_i-\alpha_i},$$

where $\chi\left(A_{it}, \tau_{it}^{w}, \tau_{it}^{k}; w_t, R_t, \alpha_i, \nu_i\right) = \left[\frac{\left(\tau_{it}^{w}\right)^{\nu_i} w_t^{\nu_i}}{\left(\tau_{it}^{k}\right)^{1-\alpha_i} R_t^{1-\alpha_i}}\right] \frac{\tau_{it}^{k} R_t}{A_{it}\alpha_i^{\alpha_i}(\nu_i)^{\nu_i}(1-\nu_i-\alpha_i)^{1-\nu_i-\alpha_i}}$. Using the definition of the intermediate input price aggregator and taking logs

$$\Delta \ln p_{it} = \Delta \ln \chi_{it} + \sum_{s=1}^{N} \left(1-\nu_i-\alpha_i\right) \gamma_{si} \Delta \ln p_{st}.$$

Then stacking across sectors we can write

$$\Delta \ln \mathbf{p}_t = \Delta \ln \chi_t + \Psi \Delta \ln \mathbf{p}_t$$
$$\Delta \ln \mathbf{p}_t = \mathcal{H} \Delta \ln \chi_t,$$

where $\Psi$ is the Leontief matrix and $\mathcal{H} = (I - \Psi)^{-1}$ its inverse such that row $i$ column $s$ element is $(1 - \nu_i - \alpha_i)\,\gamma_{si}$. Thus, relative prices across sectors will depend on the structure of the matrix $\Psi$.

**Propagation.** For $\Delta \ln \chi$ shock, the relative prices would change by

$$\Delta \ln \frac{p_{it}}{p_{jt}} = \underbrace{\mathcal{H}_{(i,i)} \Delta \ln \chi_{it} - \mathcal{H}_{(j,j)} \Delta \ln \chi_{jt}}_{\text{direct}} + \underbrace{\sum_{s \neq i \in \mathcal{I}} \mathcal{H}_{(i,s)} \Delta \ln \chi_{st} - \sum_{s \neq j \in \mathcal{I}} \mathcal{H}_{(j,s)} \Delta \ln \chi_{st}}_{\text{indirect}},$$

where $\mathcal{H}_{(i,j)}$ is the element $(i,j)$ of the $\mathcal{H}$ matrix. For example, for a shock to the labor distortion, we know that $\Delta \ln \chi_{it} = \nu_i \Delta \ln \tau^w_{it}$. Then, ceteris paribus, the dynamics of relative prices will depend, through the network, on the entire distribution of labor distortion changes, not just the relative changes between $i$ and $j$, as in the baseline model.

## B.9 Capital and Labor Substitution

Consider the case where the technology is CES, such that

$$Y_{it} = A_{it} \left[ (1 - \alpha_i)^{\frac{1}{\sigma_i^{KL}}} L_{it}^{\frac{\sigma_i^{KL}-1}{\sigma_i^{KL}}} + \alpha_i^{\frac{1}{\sigma_i^{KL}}} K_{it}^{\frac{\sigma_i^{KL}-1}{\sigma_i^{KL}}} \right]^{\frac{\sigma_i^{KL}}{\sigma_i^{KL}-1}},$$

where the capital shifter $\alpha_i$ and elasticity of substitution between capital and labor $\sigma_i^{KL}$ can be sector specific. Under this technology, the relative prices across sector also depend on $\sigma_i^{KL}$, i.e.,

$$\frac{p_{it}}{p_{jt}} = \frac{A_{jt}}{A_{it}} \frac{\tau^w_{it}}{\tau^w_{jt}} \frac{\left[ (1 - \alpha_i) + \alpha_i \left( \frac{\tau^k_{it}}{\tau^w_{it}} \right)^{1-\sigma_i^{KL}} \left( \frac{R_t}{W_t} \right)^{1-\sigma_i^{KL}} \right]^{\frac{1}{1-\sigma_i^{KL}}}}{\left[ (1 - \alpha_j) + \alpha_j \left( \frac{\tau^k_{jt}}{\tau^w_{jt}} \right)^{1-\sigma_j^{KL}} \left( \frac{R_t}{W_t} \right)^{1-\sigma_j^{KL}} \right]^{\frac{1}{1-\sigma_j^{KL}}}}.$$

Importantly, when we study the relationship between relative value added and relative employment across sectors, we find that the relative employment across sector $i$

and $j$ is

$$\frac{L_{it}}{L_{jt}} = \left(\frac{1-\alpha_i}{1-\alpha_j}\right)\left(\frac{\tau_{jt}^w}{\tau_{it}^w}\right)\frac{\omega_{it}}{\omega_{jt}}\underbrace{\left(\frac{1-\alpha_j+\alpha_j\left(\frac{W_t\tau_{jt}^w}{R_t\tau_{jt}^k}\right)^{\sigma_j^{KL}-1}}{1-\alpha_i+\alpha_i\left(\frac{W_t\tau_{it}^w}{R_t\tau_{it}^k}\right)^{\sigma_i^{KL}-1}}\right)}_{\text{CES term}}.$$

This expression is as in the baseline model, except for the last term on the right-hand side, which reflects that labor and capital can be substitutes or complements. As a result, relative input costs can affect the allocation of labor beyond what is implied by output reallocation alone.

In our baseline empirical results, we observe limited reallocation of employment to the manufacturing sector (relative to services), but substantial reallocation of value added. One hypothesis, through the lens of this model, is that if capital and labor are complements ($\sigma^{KL} < 1$) and the manufacturing sector has a higher capital share ($\alpha_i$), then an increase in the cost of capital would lead to lower employment reallocation relative to value added in manufacturing following a crisis. One challenge to this hypothesis is explaining why the relative cost of capital remains higher even a decade after the onset of the crisis.

## B.10 Imperfect Labor Mobility

We study how the relationship between value-added and employment shares changes in the model when labor is not perfectly substitutable across sectors. We assume a CES labor supply aggregator (see, for example, Bai, Lu and Wang (2024)) and total supply of labor is inelastic and normalized to 1 such that

$$\mathcal{L}\left(\mathbf{L}_t\right) \equiv \left[\sum_{i\in\mathcal{I}\cup\{0\}} \gamma_{Li}^{-\frac{1}{\sigma_L-1}} L_{it}^{\frac{\sigma_L}{\sigma_L-1}}\right]^{\frac{\sigma_L-1}{\sigma_L}} = 1,$$

where $\sigma_L$ the elasticity of substitution of labor across sectors and $\gamma_{Li}$ sector-specific labor shifters. Using the household's FOC relative to labor we can show that the relative

wage bill between sector $i$ and $j$ is

$$\frac{w_{it}L_{it}}{w_{jt}L_{jt}} = \left(\frac{\gamma_{Li}}{\gamma_{Lj}}\right)^{-\frac{1}{\sigma_L - 1}} \left(\frac{L_{it}}{L_{jt}}\right)^{\frac{\sigma_L}{\sigma_L - 1}}.$$

Combining with the firms' optimality conditions and taking time differences (in logs) we can write the employment share dynamics as

$$\Delta \ln \frac{L_{it}}{L_{jt}} = \left(\frac{\sigma_L - 1}{\sigma_L}\right) \Delta \ln \frac{\omega_{it}}{\omega_{jt}} - \Delta \ln \Omega^L_{ijt},$$

where the labor distortion is $\Omega^L_{ijt} = \left(\frac{\tau^w_{it}}{\tau^w_{jt}}\right)^{\frac{\sigma_L - 1}{\sigma_L}}$. Thus, for $\sigma_L > 1$ employment reallocation is weakly smaller than value added reallocation. A priori, this appears at odds with some of the patterns observed in the data—such as the reallocation of employment and value-added between agriculture and manufacturing—where employment shifts more than is implied by the value-added dynamics (in both the data and the model without wedges). However, it is important to note that labor mobility frictions would still manifest as movements in labor wedges following a shock that reallocates resources across sectors, even if the underlying frictions remain unchanged.