The Effects on the Indian Economy of an Expansion in Financial Capital Supply

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The Effects on the Indian Economy of an Expansion in Financial Capital Supply

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Table of contents

Abstract

International financial institutions provide capital to a range of Indian financial intermediaries, and engage with these intermediaries in a range of ways that potentially improve the allocation of capital within India. We investigate the impact on the India economy of a hypothetical rise in foreign-supplied capital to local Indian financial institution investees, and the engagement activities that might be associated with it. We do this by modelling: (a) the effects on the Indian economy of the supply of additional $US 10 b. of financial capital phased in over five years, and (b) India benefiting from the capital efficiency enhancement effects arising from engagement with the providers of this capital. We undertake our investigation with a 150 sector dynamic computable general equilibrium model of the Indian economy (NCAER-VU-DYN, or NV-DYN) which builds on an existing comparative-static model (NCAER-VU). Compared with NCAER-VU, NV-DYN contains: (i) year-on-year dynamics, (ii) a treatment of the labour market that allows for temporary unemployment, (iii) a Lewis-style mechanism governing movement of unskilled labour between rural and urban activities, and (iv) a top-down facility for calculating employment impacts by gender.

JEL Classification: C68, O16, J46.

Key words: dynamic CGE, Indian economy, capital supply.

Results in this paper are reported in terms of Indian rupees and percentage changes from baseline values. For readers interested in converting Indian rupee values to British pounds or U.S. dollars, appropriate exchange rates are 0.0111 British pound per Indian rupee and 0.0147 U.S. dollar per Indian rupee (2018 rates, consistent with the 2018 starting point for the simulations in the paper).

Key Findings

- We model the effects on the Indian economy, over the period 2018-2030, of the supply of an additional $US 10 b. (or approximately ₹ 679 b) of financial capital to Indian financial intermediaries (hereafter, “financial institution investees”).
- We find that this raises key macroeconomic indicators of Indian economic activity. On average, over 2018-30, it contributes:
  - ₹ 136 b. to real GDP;
  - ₹ 125 b. to real investment;
  - ₹ 84 b. to real private consumption; and,
  - ₹ 16 b. to real public consumption.
- The economic benefit of the additional financial capital can be measured by its contribution to real consumption (whether private or public). Annual average real consumption is raised by ₹ 100 b. (comprising ₹ 84 b. of private consumption and ₹ 16 b. of public consumption).
- The present value of the real consumption gains over 2018-30, at a 4% discount rate, is ₹ 1035 b., or ₹ 764 per person.
- On average over 2018-30, net total employment is 112 thousand positions higher than it would otherwise have been, comprising 96 thousand additional male positions and 15 thousand additional female positions.
- The job gains are concentrated in the construction and trade sectors (with average net job gains of 132 thousand and 15 thousand additional positions respectively). Some sectors experience net job losses. In particular, there are net labour flows out of agriculture and textiles (with average net job losses of 28 thousand and 20 thousand positions respectively).
- Real consumer wages are 0.08% higher than they would otherwise be.
- The output levels of most Indian sectors rise. The sectors that benefit the most are:
  - Construction (with 0.16% higher output on average)
  - Light manufacturing (with 0.09% higher output on average)
  - Utilities (with 0.06% higher output on average)
  - Forestry and fisheries (with 0.05% higher output on average)
  - Financial services (with 0.05% higher output on average).

Executive Summary

We simulate the impact of a $US 10 b. increase in the supply of capital to Indian financial intermediaries in order to understand the short and longer term dynamics of increased capital supply to the Indian economy. Recognising that the suppliers of foreign financial capital often engage with local institutions in ways that potentially enhance productivity, we were also asked to investigate the effects of a rise in investment productivity.

We phase in the financial capital supply and productivity enhancing effects over the five years 2018-22. The consequences of this over the period 2018 to 2030 are reported in Table 1 through to Table 4. We begin with a discussion of the effects of a rise in financial capital supply to Indian financial institutions (reported in Table 1 and Table 2). We then discuss the nature of the potential productivity-enhancing effects arising from engagement activities between local financial institutions and the foreign institutions providing them with additional capital (Table 3 and Table 4).

We simulate the addition of $US 10 b. (or approximately ₹ 679 b.) of additional foreign financial capital to Indian financial institutions. Compared with a base-line counterfactual scenario that excludes this investment, the phasing in of the investment over the five years 2018-22 directly raises annual Indian investment by ₹ 136 b (= ₹ 679 b / 5). To put this in context, the 2018 value of investment in the model is ₹ 52,175 b. Hence, supply of 1/5th of ₹ 679 b. of additional investment each year (approximately ₹ 136 b. p.a.) represents a direct positive impact on aggregate Indian investment of approximately 0.26 per cent.

In Table 1 we see that the average increase in annual Indian investment over 2018-22 (₹ 199 b) is somewhat higher than the direct impact (₹ 136 b). The additional annual investment of approximately ₹ 63 b. reflects the flow-on expansionary effects for other parts of the Indian economy created by the supply of additional capital to Indian financial institutions.

These flow-on expansionary effects are evident in the gains in net employment generated during the phasing in period. Annual average net job gains over the five years of the phasing in period are 235 thousand (row 9, Table 1). The net job gains are weighted towards male employment (row 7, Table 1). This is because much of the adjustment pressure is expressed in increased investment, which is intensive in the use of construction, a sector with a high male employment share. Following the investment phase-in period, net job gains gradually attenuate over the remainder of the simulation period, as real wages adjust to return unemployment rates to baseline levels.

We find that the additional $US 10 b. of capital supplied to Indian financial institutions lifts Indian annual GDP on average by ₹ 136 b. (row 1, Table 1). The peak gains in real GDP occur around the end of the financial capital phase-in period. For example, the annual GDP gain between 2021 and 2023 is ₹ 163 b. However, the GDP gains are sustained throughout the simulation period, and extend into the long-run. Even in the final year of the simulation period (2030), real GDP is ₹ 142 b. higher than it would have otherwise been.

The economic benefit generated by the additional capital can be measured in terms of the increase in real private and public consumption spending. In rows 3 and 5 of Table 1, we see that the simulated expansion in loan capital supply causes average annual real private and public consumption spending to be ₹ 100 b. (=₹ 84 b. + ₹ 16 b.) higher than otherwise. The present value of the real consumption gains over 2018-30, at a 4% discount rate, is ₹ 1035 b., or ₹ 764 per capita.

Table 2 reports net employment impacts by sector. Over the capital phase-in period (2018-22) there are large net job gains, particularly in the construction sector (row 10, Table 2). In the longer-run, wage adjustment returns unemployment rates to baseline levels. Hence, the aggregate net job gains have largely disappeared by 2030. This makes more apparent the long-run structural consequences of the supply of additional capital to financial institutions. The largest structural effect is that approximately 42 thousand persons (in net terms) move out of agricultural employment, and a further net 11 thousand persons move out of textiles employment. The labour moving from these sectors is largely absorbed by the construction sector. As we describe in the body of the report, the movement of labour out of agriculture contributes to the economic gains from supply of additional financial capital, because the marginal product of labour within agriculture is lower than in other sectors.

Table 3 and Table 4 report the effects of the potential productivity-enhancing effects that might arise from engagement activities between foreign capital suppliers and their local financial institution investees. We model this by raising by 5% the efficiency of capital formation over 2018-22 for ₹ 136 b (= ₹ 679 b / 5) of annual investment. We choose 5% for illustrative purposes. Our results can be scaled in future as information on the potential magnitude of this effect is collected. One way of thinking about a 5% gain in the efficiency of capital formation is that it means 5% fewer resources must be used to construct a unit of physical capital.

Because the investment productivity shock is only 5% of the value of the capital supplied, the results of the investment productivity simulation are an order of magnitude smaller than those of the investment supply simulation. Nevertheless, because both simulations relate to investment, the results are qualitatively similar.

The improvement in investment efficiency over the investment supply period raises rates of return on capital, thereby causing Indian investment to be higher by approximately ₹ 4 b. per year over 2018-22 (row 2, Table 3). Initially, the improvement in investment efficiency causes net economy-wide employment to fall relative to baseline (3.8 thousand positions in 2018, see row 9, Table 3). This reflects a fall in net employment in the construction sector during the investment efficiency enhancement period (see row 10, Table 4). The fall in construction employment is caused by the rise in investment efficiency, which requires that fewer inputs (including labour) are required per unit of investment. While this increases investment activity (row 2, Table 3), the impact of this positive activity effect on construction employment is insufficient to offset the direct effect of requiring fewer inputs (like labour) per unit of investment. However, after 2018, the general expansionary effects of the rise in investment, together with the fact that the ongoing size of the capital stock is now increased by the investment efficiency gain, are sufficient to cause generalised job gains outside of construction to more than offset the temporary employment losses in construction (see Table 4). This causes aggregate net employment to rise relative to baseline from 2019 onwards. These employment gains reach their highest point in 2022, at 5.3 thousand net additional positions (row 9, Table 3). Thereafter, net employment gradually returns to baseline, as real wage adjustment returns unemployment rates back towards baseline levels.

The enhancement of investment efficiency, together with the short-run expansionary effects generated by the increase in investment, cause real GDP to be higher by approximately ₹ 8 b. on average in each year of the phase-in period (row 1, Table 3). The real GDP gain moderates somewhat after the end of the investment phase-in period (i.e. from 2023 onwards). Nevertheless, there remains a persistent expansion in real GDP, of approximately ₹ 2 b. by the end of the simulation period. This reflects the expansion of the Indian capital stock generated by the positive investment and productivity effects over 2018-22.

The economic benefit generated by the efficiency-enhancing elements of engagement activities with local financial institution investees can be measured by the additional real private and public consumption spending that this generates. In rows 3 and 5 of Table 3 we see that the increase in investment efficiency causes average annual real private and public consumption spending to be ₹ 1.6 b. (=₹ 1.3 b. + ₹ 0.3 b.) higher than otherwise. The present value of the real consumption gains over 2018-30, at a 4% discount rate, is ₹ 15 b., or ₹ 11 per capita.

Technical Summary

(i) This report describes the creation of NV-DYN, a dynamic economic model of India, and its application to the investigation of the economic effects of a rise in the supply of financial capital to Indian financial institutions.

(ii) We model the economic effects of an increase in the supply of capital to Indian financial institutions in two ways:

a. We raise the supply of financial capital to Indian financial institutions by $US 10 b. This raises India's investment activity in the short-run and capital stock in the long-run. We call this the **investment supply** simulation. The results from this simulation are summarised in Table 5 and Table 6.

b. We raise capital formation efficiency over $US 10 b. of investment Indian investment activity. This raises India's productive efficiency in the short-run and capital stock in the long-run. We call this the **investment productivity** simulation. The results from this simulation are summarised in Table 7 and Table 8.

(iii) Both simulations are undertaken against a baseline simulation for the Indian economy covering 2018-2030 that excludes the additional financial capital and associated increase in investment productivity. We report results as deviations away from baseline values.

(iv) In forming a view about the sectoral allocation of the new financial capital and the rise in capital formation productivity, we followed the sectoral allocation reported in Table 9.

(v) In the **investment supply simulation**, the value of Indian investment is approximately 0.34% higher than baseline over 2018-22 (row 3, Table 5).

(vi) The size of the Indian capital stock is directly related to investment activity, because investment in any one year adds to capital supply in future years. Hence, the investment supply over 2018-22 causes the Indian capital stock to grow relative to what it would otherwise have been. By 2023, the Indian capital stock is 0.16% higher than baseline (row 10, Table 5).

(vii) The expansion in the capital stock, together with the rise in aggregate demand generated by the additional investment activity, causes total employment to be higher than baseline over 2018-22 (row 7, Table 5). The highest point of the net employment gains occurs in 2020 when total employment (measured in hours) is 0.042% higher than baseline. However, the measure of employment relevant to determining real GDP (that is, total employment weighted by wage rates) is higher still, at 0.057% above baseline (row 8, Table 5). The difference between the two employment measures reflects movement of unskilled labour out of agriculture, where its marginal product is comparatively low.

(viii) The expansion in the capital stock, together with the rise in economy-wide net employment, causes India’s real GDP to rise relative to baseline over the investment supply period. On average, real GDP is 0.06% above baseline over 2018-22 (row 1, Table 5).

(ix) Following the investment supply period, real wage adjustment gradually returns unemployment rates back to baseline levels. Hence, economy-wide net employment gradually returns to baseline over 2023-30 (row 7, Table 5). For this to occur, real wages must rise by 0.09% relative to baseline (row 9, Table 5).

(x) The rise in real wages occurs because the additional supply of investment funding to Indian financial institutions causes the Indian capital stock to expand. Over 2023-30, India’s capital stock is 0.15% higher than baseline on average (row 10, Table 5). With more capital, India’s workers are more productive, and thus their real wage must rise.

(xi) Over 2023-30, the rise in India’s capital stock, together with the transitory rise in economy-wide net employment (net employment is gradually returning back to baseline throughout this period), causes India’s real GDP to be, on average, 0.04% higher than it would otherwise have been (row 1, Table 5).

(xii) Over the investment supply period (2018-22) output of the *construction* sector is 0.30% higher than it would otherwise have been (row 10, Table 6). This reflects the expansion in aggregate investment over this period. *Construction* is the sector that expands the most in the short-run, but it is also among the main beneficiaries in the long-run. Over 2023-30, *construction* output is 0.09% higher than it would otherwise have been. This reflects the expansion in India’s capital stock: with a larger capital stock, a higher level of investment (and thus *construction* output) is required to sustain a given rate of capital growth.

(xiii) Other sectors to be positively affected by the supply of additional funding to Indian financial institutions are those described in Table 9 as relatively reliant on funding by the financial institution investees intermediating the additional foreign financial capital (like *light manufacturing* and *utilities,* rows 7 and 9, Table 6), and / or those that are otherwise relatively capital intensive (like *communications* and *financial services,* rows 13 and 14, Table 6).

(xiv) In the **investment productivity** simulation, we raise the efficiency of capital formation over 2018-22 by 5% over a value of investment equal to that supplied under the investment supply simulation. We choose 5% for illustrative purposes. Our results can be scaled in future as information on the potential magnitude of this effect is collected. A 5% improvement in the efficiency of capital formation means that 5% fewer resources are needed to secure a unit of physical capital.

(xv) Because the investment productivity shock is only 5%, the results of the investment productivity simulation are about an order of magnitude smaller than those of the investment supply simulation. Nevertheless, because both simulations relate to investment, the results are qualitatively similar. Also, the efficiency enhancement has an industry dimension, related to the sectoral allocation of lending activity described in Table 9. Hence, the distribution of sectoral impacts is also similar to those of the investment supply simulation.

(xvi) The enhancement of investment efficiency over 2018-22 raises Indian investment, and thus raises the Indian capital stock. Over the investment supply period, investment is 0.0077% higher than it would otherwise have been (row 3, Table 7). This raises the Indian capital stock over this period by, on average 0.0016% relative to baseline (row 10, Table 7). Together, the rise in productivity, together with the rise in capital, causes Indian net employment to be, on average, 0.0004% higher than baseline over 2018-23 (row 7, Table 7). Over 2018-22, the higher productivity, capital stock, and economy-wide net employment, cause Indian real GDP to be, on average, 0.0044% higher than baseline (row 1, Table 7).

(xvii) Over 2023-30, the positive net employment deviation gradually attenuates, as real wage adjustment returns unemployment rates to baseline. On average, the real wage is 0.002% higher than baseline over the period (row 9, Table 7). The real wage must rise, because the Indian capital stock is higher than baseline over 2023-30. On average, the capital stock is 0.0027% larger than it would otherwise have been over this period (row 10, Table 7). This reflects the fact that, over 2018-22, a given dollar of investment spending delivers more physical capital supply (because of the investment efficiency enhancement), and because, over this period, investors are slightly more willing to undertake investment because the investment efficiency enhancement raises expected rates of return.

(xviii) The rise in the capital stock over 2023-30 causes Indian real GDP to be higher than it would otherwise have been. On average over this period, the positive deviation in real GDP is 0.0015% (row 1, Table 7).

(xix) During the investment efficiency enhancement period (2018-22), *construction* output experiences a small (-0.0039%) fall in output (row 10, Table 8), despite the rise in investment spending over this period (row 3, Table 7). This reflects the need for fewer inputs (like *construction* services) to secure a given unit of physical capital.

(xx) Over the latter part of the simulation period (2023-30), the sectors most favourably affected by the investment efficiency enhancement are similar to those favourably affected by the investment supply, namely, sectors relatively reliant on the financial institution investees intermediating the additional foreign capital (and thus more exposed to the efficiency enhancement when this funding is supplied) and / or those that are relatively capital intensive. This explains the presence of *light manufacturing*, *communications*, *financial services*, and *utilities* among the most favourably affected sectors over this period (rows 7, 13, 14 and 9, Table 8).

(xxi) We conclude the paper with suggestions on future work. These relate to greater industry detail, exploring implications for India's regions, tracing household income and expenditure distributional effects, and exploring widening the modelling of informality in the labour market.

1 Introduction and overview of results

National Council of Applied Economic Research (hereafter, NCAER) and Centre of Policy Studies (hereafter, CoPS) investigated the economic effects of a hypothetical $US 10 b. expansion in the supply of financial capital to financial institutions in India. To do this, we developed a dynamic computable general equilibrium model of the Indian economy from an existing comparative static model, and used the new model to investigate the effects of expanding capital supply to India by $US 10 b. phased in over a five-year period.[1] We assume that there are two effects of this lending: (i) a rise in financial capital supply to the Indian economy, resulting in a higher rate of physical capital accumulation, (ii) a rise in the efficiency of capital formation covering the value of the capital funded by the additional inflow of funds. In calibrating the sectoral allocation of funds in the first simulation, we used data provided by a major foreign capital supplier of the 2018 loan book of its Indian financial institution investees classified by sector (Table 9). In calibrating the second simulation, we assume that the efficiency of capital formation funded by the new capital inflow is 5% higher, with the sectoral distribution of these efficiency gains weighted in accordance with the sectoral allocation of lending activity reported in Table 9. This productivity shock is illustrative, and can be scaled in future as evidence is assembled of the efficiency-enhancing effects of engagements between foreign financial institutions and their Indian financial institution investees.

Table 5 - Table 8 summarise the results from these simulations, reporting selected macroeconomic and industrial output results for the investment supply and productivity simulations. All results are reported as percentage deviations away from baseline values.

[1] As discussed in Dixon et al. (1992) computable general equilibrium (CGE) models emphasise resource constraints, inter-industry and inter-agent linkages, price-responsive optimising behaviour, and a wide range of tax and expenditure policy instruments. They can be contrasted with input-output (IO) models, which, while sharing CGE's emphasis on inter-industry linkages and an economy-wide framework, nevertheless ultimately have an unrealistic conception of the workings of the economy, by failing to account for resource constraints, price responsive optimising behaviour, or diverse policy instruments. The absence of resource constraints in IO models is a key limitation, particularly in the context of the type of impact analysis being undertaken in the present paper. The absence of resource constraints in IO models leads them to significantly over-estimate the economic damage from adverse shocks (and similarly, over-estimate the benefits from positive shocks). In contrast, CGE models allow economic actors to respond to adverse shocks by moving resources out of the directly affected sectors, and into other, albeit perhaps less well remunerated, activities. Economic damage (and benefit) in these models is more accurately and realistically evaluated taking into account: (i) changes in the distribution of resources across sectors with different margins between market prices and production costs; (ii) changes in productive efficiency; (iii) changes in the terms of trade; and (iv) changes in the supply of capital.

Table 5 reports the macroeconomic effects of expanding the supply of financial capital to Indian financial institutions by $US 10 b. We assume that the supply of this new capital is phased in over a five-year period 2018-22. This accounts for the positive deviation (approximately one third of one percent) in annual investment spending over the period (row 3, Table 5). By 2024, this expands the Indian capital stock by 0.16 per cent relative to baseline (row 10, Table 5). Most of this expansion is due to the extra capital funding connected to the $US 10 b. financial capital supply shock. However, a small part of the capital growth is also due to the generalised expansion in economic activity induced by supply of capital funding. This accounts for the slight retracing of the capital stock deviation by the end of the simulation period (0.14% relative to baseline by 2030), in line with the gradual return of employment to baseline by the end of the simulation period (row 7, Table 5). Long-run investment is higher than baseline (0.10% by 2030) because of the long-run expansion in the capital stock.

The wider increase in Indian activity generated during the investment supply period is apparent in the positive deviation in employment (rows 7 and 8, Table 5). The deviation in employment (measured in hours) reaches a high of 0.04%, before gradually returning to its baseline level (row 7, Table 5). The mechanism that allows gradual return of employment to baseline is an increase in the real wage relative to baseline (row 9, Table 5). By the end of the simulation period, the real wage is projected to be 0.09% above baseline. This reflects the long-run increase in the capital / labour ratio (compare rows 10 and 8, Table 5). We distinguish between aggregate employment measured in total hours worked (row 7, Table 5) and aggregate employment measured as the wage-weighted sum of occupation-specific employment (row 8, Table 5). The latter is important for measuring the effects of the movement of unskilled labour between rural and urban uses (this is important because the marginal product of unskilled labour is different across these uses).

The positive deviations in employment (row 8, Table 5) and the capital stock (row 10, Table 5) cause a positive deviation in real GDP (row 1, Table 5). This reaches its highest point over 2021-2023, when the employment and capital deviations are at their highest points, before declining somewhat towards the end of the simulation period, in line with the return of employment to baseline (row 8, Table 5) and partial return of the capital deviation to baseline (row 10, Table 5). The positive GDP deviation, together with a short-run positive deviation in the terms of trade (row 12, Table 5), causes real private (row 2, Table 5) and public (row 4, Table 5) consumption to be above baseline over the simulation period.

As noted above, the initial macroeconomic effect of increasing the supply of capital to Indian financial institutions is to increase investment activity and the capital stock. This has implications for sectoral output impacts, which we report in Table 6 (according to the sectoral classification of the financial institution investee data, see Table 9). The sectors that are most positively affected are those: (i) involved in supplying inputs to the process of capital formation (like *construction*); (ii) are relatively reliant on financial investee capital (like *light manufacturing* and *utilities*); and/or (iii) are otherwise relatively capital intensive (like *communications* and *financial services*).

As discussed in Section 3, we assume that the engagement between foreign capital suppliers and their Indian financial institution investees has the potential to improve capital efficiency. To model this, we assume that the investment undertaken with the $US 10 b. of additional funds will be undertaken 5% more efficiently than would otherwise be the case. Table 7 and Table 8 report the macroeconomic and industry effects of this assumed 5% efficiency premium. Because these shocks relate only to the efficiency gain (5%) on the investment supply reported in Table 5 and Table 6, the magnitude of the impacts are correspondingly much lower in Table 7 and Table 8. Nevertheless, because they both relate to investment activity, they are qualitatively similar. The increase in investment efficiency over 2018-22 lowers the cost of capital formation, which raises rates of return and thus increases investment relative to baseline (row 3, Table 7). This generates a positive deviation in the capital stock (row 10, Table 7). The improvement to investment efficiency, together with the positive deviation in the capital stock, causes a short-run positive deviation in employment (row 7, Table 7), although this is gradually reduced over the longer run via a rise in the real wage (row 9, Table 7). The improvement to investment efficiency, together with transitory employment gain and the permanent capital increase generate positive deviations in real GDP (row 1, Table 7) and private and public consumption spending (rows 2 and 4, Table 7) over much of the simulation period.

Table 8 reports output deviations classified by sector. An interesting short-run result is the negative deviation in *construction* output (row 10, Table 8). We model the improvement to investment efficiency as a decrease in input requirements per unit of capital created. In the short-run, this lowers demand for *construction* inputs by more than the positive investment deviation raises it. In the long-run, the sectors that are positively affected by the improvement to investment efficiency again tend to be those that are capital-intensive and/or relatively reliant on funds provided by the financial institution investees as described in Table 9. This explains the presence of *light manufacturing*, *communications*, *financial services*, and *utilities* among the highly ranked sectors classified by 2030 output deviation. *Business services* is also among the more positively affected sectors, despite not being capital intensive. This reflects real depreciation during the investment efficiency improvement period (row 11, Table 7), which raises the relative competitiveness of this trade exposed sector.

The remainder of this report is structured as follows. Section 2 describes the model, explaining how an existing comparative static model of India was developed into a dynamic model for the purpose of this report. Section 3 describes how we calculate the input shocks to the economic model. Section 4 describes the results of our simulations with the model. Section 5 concludes with a discussion of possible future extensions to the work.

2 The NCAER-VU-DYN (NV-DYN) model

2.1 Introduction

The starting point for the model used in this paper is the NCAER-VU model. As described in Dixon et al. (2016), the NCAER-VU model is based on GEMPACK code written by Horridge (2000) for the ORANI-G model. ORANI-G is a generic version of the ORANI model, which was originally implemented with Australian data (see Dixon et al. 1977 and 1982). The NCAER-VU model is calibrated to an initial 2007-08 solution year using official India Statistics (IS) data. The model contains 150 sectors, and includes regional details on production technologies and subsidies for six agricultural industries (paddy, wheat, coarse cereals, sugarcane, oil seeds and cotton). The model is comparative static, meaning that simulations of the model show how an economic shock (say, a change in productivity) will affect the economy in some future year in either the short-run (say, 2-3 years after the shock) or the long-run (say 7+ years after the shock), but without tracing a time path for how the economy moves from its current position to its future short-run or long-run positions. For this paper, we transform NCAER-VU into a dynamic model, hereafter NCAER-VU-DYN, or NV-DYN. Specifically, we make the following adjustments and improvements to the NCAER-VU model:

(a) We update the database to create an initial solution to the model for 2016.

(b) We add dynamic equations to model capital and net foreign asset accumulation.

(c) We add a wage determination process that allows wages to be sticky in the short-run and flexible in the long-run.

(d) We add a Lewis-style mechanism governing remuneration of agricultural labour and mobility between rural and urban sectors.

(e) We add a top-down extension to compute employment by gender.

In the remainder of this section, we begin by outlining the key features of the starting point for the development of NV-DYN (namely, the NCAER-VU model). We then expand on the above five developments which move NCAER-VU to NV-DYN. Finally, we describe relevant elements of the model's closure in the policy simulation.

2.2 Overview of the NCAER-VU and NV-DYN models

As discussed above, the model used in this paper (NV-DYN) is an updated and dynamic version of the comparative static model NCAER-VU. As such, NV-DYN shares in common with NCAER-VU many of the theoretical assumptions governing the behaviour of key economic institutions (like households, industries, and government) and the interactions between them. We summarise below the key assumptions and features of NCAER-VU that carry over to NV-DYN.

NV-DYN models the behaviour of economic agents within the industrial, investment, household, government and foreign sectors, and identifies a large number of industries and commodities. In general, neoclassical assumptions govern the behaviour of the model's economic agents. The model contains 150 industries, representing the activities and decision making of individual enterprises within the Indian economy. Each representative industry is assumed to minimise its production costs subject to industry-specific constant-returns-to-scale production technologies and given input prices. A representative household is assumed to maximise utility by choosing between 150 commodities sourced from India and overseas, subject to given consumer prices and a budget constraint determined by post-tax income from a variety of sources. Investors allocate new capital to industries on the basis of expected rates of return. Units of new industry-specific capital are assumed to be cost-minimising combinations of inputs sourced from India and overseas. The technology for making new units of capital differs across sectors. For each agent in the model, imperfect substitutability between the imported and domestic sources of supply for each commodity are modelled using the constant elasticity (CES) assumption of Armington. In general, markets are assumed to clear and to be competitive. Purchaser's prices differ from basic prices by the value of indirect taxes and margin services. Taxes and margins can differ across commodities, users, and sources. Foreign demand for each commodity is modelled as inversely related to its foreign currency price. The model includes details of the taxing, spending and transfer activities of a single representative government.

As described further below, dynamic equations describe stock-flow relationships, such as those between regional industry capital stocks and regional industry investment. Dynamic adjustment equations allow for the gradual movement of a number of labour market variables towards their long-run values. In particular, we allow unemployment rates to temporarily depart from baseline values under an assumption of short-run wage stickiness. Over time, wage adjustment gradually returns unemployment rates to baseline.

Economic linkages between sectors arise from industry inter-connections via intermediate input use and competition for scarce factors of production, the linking of household consumption to post tax income from factor returns and other sources, and the taxing and spending activities of the representative government. The model evaluates a full set of national income accounts, and associated deflators, along with results for diverse indicators of industry activity, including output, investment, employment, prices and profitability.

2.3 Updating the database

As documented in Dixon et al. (2016), the preparation of the NCAER-VU database involved careful and meticulous work. Creating a new database from the latest IS input-output data was not possible within the resources available for this project, and would in any case be an unnecessary expense given the care with which the initial NCAER-VU database was constructed, and the availability of good options for updating it. In particular, Horridge (2004) documents a flexible algorithm for updating a CGE database that can accommodate varying degrees of external information. We update the NCAER-VU database to 2016 using the Horridge (2004) method. During the update, we inflate the database by the movement in nominal GDP between 2008 and 2016, and force the database's implicit values for private consumption, public consumption, investment, exports and imports to equal 2016 official national accounts values. The resulting updated database thus conforms to official national accounts data for 2016, while preserving the details of the input and sales structures that were carefully compiled and investigated in the construction of the 2008 initial solution to the NCAER-VU model.

2.4 Equipping the model with dynamics

Three dynamic processes distinguish NV-DYN from NCAER-VU: two describe stock/flow relationships, one between capital and investment, and the other between the current account deficit and net foreign liabilities; and one describes a process of lagged adjustment in wages to changes in labour market conditions. Broadly, these mechanisms draw together the investment theory, net foreign asset accounting, and labour market theory of Dixon and Rimmer (2002). Before describing these mechanisms, we first distinguish two types of dynamic simulation: baseline and counterfactual (Dixon and Rimmer 2002;15). The baseline simulation is a business-as-usual forecast for the Indian economy. The counterfactual simulation is identical to the baseline simulation in all respects other than the addition of shocks describing the issue under analysis (in this case, the supply of $US 10 b. of additional financial capital and possible associated efficiency gains in investment undertakings). The distinction between baseline and counterfactual is important for two reasons. First, the theory governing wage determination relies on the distinction. Second, we present model results as deviations in the values of variables in the counterfactual simulation away from their corresponding values in the baseline.

NV-DYN carries the assumption that investment undertaken in industry i in year t becomes operational at the beginning of year $t+1$. That is:

$$K_{i,t+1} = K_{i,t}(1 - D_i) + I_{i,t} \quad \text{(E1)}$$

where

$K_{i,t}$ is industry *i*'s capital stock in year *t*.

D_i is industry *i*'s depreciation rate.

$I_{i,t}$ is the quantity of new capital created for industry *i* during year *t*.

Investment is assumed to be a function of the expected rate of return on capital relative to the required rate of return on capital, via:

$$K_{i,t+1} / K_{i,t} - 1 = F_{i,t}[EROR_{i,t} / RROR_{i,t}] \quad \text{(E2)}$$

where

$EROR_{i,t}$ is the expected rate of return on investment in industry *i* in year *t;*

$RROR_{i,t}$ is the required rate of return on investment in industry *i* in year *t;*and

$F_{i,t}$ [ ] is an increasing function of the expected rate of return.

In implementing (E2), we assume that $F_{i,t}$ takes the inverse-logistic form described in Dixon and Rimmer (2002; 190-195).

NV-DYN allows for limited deviations in short-run wages away from their baseline forecast values. This wage stickiness allows short-run labour market pressures to be mainly manifested as short-run deviations in employment. More explicitly, the paths for occupation-specific wage rates in the counterfactual simulation are governed by:

$$\left(W_{o,t}^{(C)}/W_{o,t}^{(B)} - 1\right) = \left(W_{o,t\text{-}1}^{(C)}/W_{o,t\text{-}1}^{(B)} - 1\right) + \alpha\left(E_{o,t}^{(C)}/E_{o,t}^{(B)} - 1\right) \quad \text{(E3)}$$

where

$W_{o,t}^{(B)}$ and $W_{o,t}^{(C)}$ are year *t* values for the nominal wage in occupation *o* (*o* $\in$ {skilled, unskilled}) in the baseline and counterfactual simulation respectively;

$E_{o,t}^{(B)}$ and $E_{o,t}^{(C)}$	are employment in occupation *o* in the baseline and counterfactual simulations respectively; and
α	is a positive parameter.

With (E3) activated in the counterfactual simulation, the deviation in the wage rate for occupation *o* grows (declines) as long as employment in occupation *o* remains above (below) its baseline level. (E3) describes the sticky wage mechanism in Dixon and Rimmer (2002, p. 205). We choose a value for α that ensures that the bulk of the employment effects of a shock in year *t* are eliminated by year *t* + 5.

As a comparative static model, NCAER-VU contains no accounting for foreign debt accumulation. We add this in constructing NV-DYN. We begin by linking foreign debt accumulation to the current account deficit via (E4)

$$FD\_T1 = FD\_T + CAD \qquad (E4)$$

where FD_T and FD_T1 are foreign debt in years t and t+1 and CAD is the current account deficit.

We define CAD via (E5):

$$CAD = VCIF - VEXP + INT\_FD - FTRANS \qquad (E5)$$

where VCIF is the c.i.f. value of imports, VEXP is the f.o.b. value of exports, INT_FD is net interest on the foreign debt, and FTRANS is net unrequited foreign transfers to India.

We define net interest payments on the foreign debt via (E6):

$$INT\_FD = ROIFOR \times FD\_T \qquad (E6)$$

where ROIFOR is the average rate of interest on India's foreign debt. We define ROIFOR via (E7):

$$ROIFOR = SH\_NEW \times ROINEW + SH\_BAS \times ROIBAS \quad \text{(E7)}$$

where SH_NEW and SH_BAS are the shares of India's net foreign debt represented by the hypothetical new funding and existing sources respectively (with SH_NEW + SH_BAS = 1), and ROINEW and ROIBAS are the costs of foreign capital supplied by the new and existing sources respectively. If ROINEW and ROIBAS are different, (E7) allows the new supply of capital to Indian financial institutions to affect the average cost of foreign capital to India and thus affect national income. At present, in the absence of information on this, we set ROINEW = ROIBAS. We calculate gross national product via (E8):

$$GNP = GDP - INT\_FD + FTRANS \quad \text{(E8)}$$

where GNP is nominal gross national product and GDP is nominal GDP at market prices. We link consumption spending to GNP via (E9):

$$C + G = APC \times GNP \quad \text{(E9)}$$

where C and G are nominal private and public consumption respectively, and APC is the propensity to consume out of gross national product. With APC exogenous, (E9) links national consumption (private and public) to GNP. We determine the split between private and public consumption spending by exogenously determining Γ in (E10):

$$CR / GR = \Gamma \quad \text{(E10)}$$

where CR and GR are real private and real public consumption, and Γ is the ratio of real private to real public consumption.

2.5 Modelling surplus rural labour

We model the Indian labour market as being characterised by Lewis-style surplus labour in the agricultural sector. We model surplus agricultural labour using the theory outlined in Mariano and Giesecke (2016), which in turn is based on the rural-urban migration theory of Mai et al. (2014).

In modelling surplus agricultural labour within NV-DYN, we make the following assumptions:

(i) We identify two occupations (unskilled and skilled) which together comprise the set of occupations OCC.

(ii) The set of occupations is divided into two subsets. The first subset (AGOCC = {unskilled}) comprises those workers who receive a share of agricultural land rents when they work in agriculture. The second subset (NONAGOCC = {skilled}) do not receive a share of agricultural land rents when they work in agriculture.

(iii) The remuneration of AGOCC workers differs, depending on whether they are employed within agriculture or outside agriculture, in particular:

(a) The remuneration of workers in AGOCC occupations employed within the agricultural sector ($\mathrm{REM}_{(o)}^{\mathrm{Agind}}, \quad o \in \mathrm{AGOCC}$) is based on their average product in agriculture.

(b) The remuneration of workers in AGOCC occupations employed within the non-agricultural sector ($\mathrm{REM}_{(o)}^{\mathrm{NonAgind}}, \quad o \in \mathrm{AGOCC}$) is based on their marginal product outside agriculture.

(iv) AGOCC workers move between agricultural and non-agricultural sectors under an assumption of a given exogenous ratio of $\mathrm{REM}_{(o)}^{\mathrm{Agind}}$ to $\mathrm{REM}_{(o)}^{\mathrm{NonAgind}}$ ($o \in \mathrm{AGOCC}$).

We define remuneration of AGOCC workers working within agricultural industries via

$$REM_{(o)}^{Agind} = \frac{\sum_{i \in AGIND} V1LND_{(i)}}{\sum_{k \in AGOCC} \sum_{i \in AGIND} Q1LAB_{(k,i)}} + \frac{\sum_{i \in AGIND} V1LAB_{(o,i)}}{\sum_{i \in AGIND} Q1LAB_{(o,i)}} \qquad (o \in \mathrm{AGOCC}) \qquad \text{(E11)}$$

Where

IND = {full set of industries, *i1*, *i2*, …, *i150*}.

AGIND = {44 agricultural industries}, a subset of IND.

$REM^{Agind}_{(o)}$ (o ∈ AGOCC) is the average hourly remuneration of unskilled workers in the agricultural sector.

$V1LAB_{(o,i)}$ (o ∈ OCC) (i ∈ IND) are the returns to labour (defined as the marginal product of labour per hour multiplied by the number of hours of work) of occupation *o* in industry *i*.

$Q1LAB_{(o,i)}$ (o ∈ OCC) (i ∈ IND) is the quantity of occupation *o* in industry *i*.

$V1LND_{(i)}$ (i ∈ IND) are the returns to natural resources employed in industry *i*.

Equation (E11) allows us to recognise that, with the marginal product of labour potentially low in agriculture, consistent with the idea of their being surplus labour in agricultural activities, it is unlikely to be appropriate to model remuneration of unskilled workers in agriculture as being solely on a marginal product basis. Hence, we implement (E11), allowing remuneration of AGOCC workers to be determined more by their average product than by their marginal product. Equation (E11) defines the hourly remuneration of AGOCC workers employed in the agricultural sector as the sum of their share of land rents in agriculture plus the value of their marginal product of labour.

Movements of AGOCC labour between agriculture and the rest of the economy are endogenised under an assumption that the ratio of remuneration rates available to AGOCC labour within and outside agriculture is given. This might reflect a given wage relativity between the two broad sectors, perhaps arising from differences in job characteristics, or institutional features like unions within the formal urban labour market that are sufficiently strong to maintain high wages in the face of supply of rural workers willing to accept jobs at lower wages. This condition is described by:

$$WAGE_{(o,i)} = REM^{Agind}_{(o)} \times F_{(o,i)} \qquad (\text{o} \in \text{AGOCC})\ (\text{i} \in \text{NONAGIND}) \qquad \text{(E12)}$$

where

NONAGIND = {106 non-agricultural industries}, a subset of IND;

$WAGE_{(o,i)}$ is the nominal wage of worker *o* employed in industry *i*;

$F_{(o,i)}$ is the ratio of the wage available to AGOCC worker *o* outside agriculture relative to the remuneration available to AGOCC worker *o* within agriculture.

With $F_{(o,i)}$ exogenous, we have in place a theory that allows a given number of AGOCC workers to move between agricultural and non-agricultural industries. However, we need to determine the “given number" of AGOCC workers. We have two options:

(1) Determine the number of AGOCC workers exogenously. This would be appropriate in forecast simulations, where the modeller has an independent view on labour supply by occupation. But in many applications, the modeller has a view on labour supply in aggregate, but not its occupational composition. In these circumstances, we can adopt option (2).

(2) Exogenously determine the ratio of AGOCC worker remuneration to NONAGOCC remuneration. We assume in the baseline forecast that the ratio of the average remuneration of workers in the set AGOCC ($AVG\_REM_{(o)}^{Agocc}$) to the average remuneration of workers in the set NONAGOCC ($AVG\_WAGE^{Nonagocc}$) is exogenous and unchanged, with maintenance of this relativity ensured by labour mobility between occupations.

We adopt the second assumption in our baseline forecast simulation, and implement it via the exogenous determination of $F\_AVG\_REM_{(o)}$ in equation (E13):

$$AVG\_REM_{(o)}^{Agocc} = AVG\_WAGE^{Nonagocc} \times F\_AVG\_REM_{(o)} \qquad (\mathrm{o} \in \mathrm{AGOCC}) \qquad \text{(E13)}$$

where $AVG\_REM_{(o)}^{Agocc}$ is the average remuneration of workers in agricultural occupation o ($\mathrm{o} \in \mathrm{AGOCC}$), and $AVG\_WAGE^{Nonagocc}$ is the average wage of workers in the set NONAGOCC. We define these terms as follows:

$$AVG\_REM_{(o)}^{Agocc} = \sum_{i \in AGIND} S_{(o,i)}^{(1)} \times REM_{(o)}^{Agind} + \sum_{i \in NONAGIND} S_{(o,i)}^{(1)} \times WAGE_{(o,i)} \qquad (o \in AGOCC) \qquad \text{(E14)}$$

$$AVG\_WAGE^{Nonagocc} = \sum_{o \in NONAGOCC} \sum_{i \in IND} S_{(o,i)}^{(2)} \times WAGE_{(o,i)} \qquad \text{(E15)}$$

where

$S_{(o,i)}^{(1)}$ is the share of total employment of labour of occupation type o represented by employment in industry i, that is, $S_{(o,i)}^{(1)} = Q1LAB_{(o,i)} / \sum_{j \in IND} Q1LAB_{(o,j)}$.

$S^{(2)}_{(o,i)}$ is the share of total employment of NONAGOCC workers represented by employment in occupation o in industry i, that is, $S^{(2)}_{(o,i)} = Q1LAB_{(o,i)} / \sum_{k \in NONAGOCC} \sum_{j \in IND} Q1LAB_{(k,j)}$, ($o \in$ NONAGOCC) ($i \in$ IND).

2.6 *Employment by gender extension*

NV-DYN calculates cost-minimising demands for employment classified by 150 industries. Because ratios of employment classified by sex differ widely across Indian industries, a top-down extension can be helpful in providing insights into potential employment impacts by sex. We add such an extension, using the general top-down framework described in Dixon et al. (2007), which in its basic form is:

$$\text{varD}_{(i)} = \text{var} + \text{relevantD}_{(i)} - \sum_{g \in SET} \text{SHVAR}_{(g)} \times \text{relevantD}_{(g)} \qquad (i \in SET) \qquad \text{(E16)}$$

where SET comprises the elements for which a top-down solution is being calculated (e.g. male, female); $\text{varD}_{(i)}$ is the variable for which a decomposed solution is being calculated (e.g. employment by sex); var is the corresponding economy-wide variable; $\text{relevantD}_{(i)}$ is a variable relevant to determining the gap between $\text{varD}_{(i)}$ and var; and $\text{SHVAR}_{(i)}$ is the coefficient giving the share of (i) in the national value of var. When we apply this framework to calculating employment by gender, we have:

$$\text{xemp}_{(s,j)} = \text{emp}_{(j)} \qquad (s \in GENDER)(j \in IND) \qquad \text{(E17)}$$

$$\text{relempgen}_{(s)} = \sum_{j \in IND} \text{SHINDGEN}_{(j,s)} \times \text{xemp}_{(j,s)} \qquad (s \in GENDER) \qquad \text{(E18)}$$

$$\text{empgen}_{(s)} = \text{empnat} + \text{relempgen}_{(s)} - \sum_{k \in SET} \text{SHGEN}_{(k)} \times \text{relempgen}_{(k)} \qquad (s \in GENDER) \qquad \text{(E19)}$$

Equation (E17) calculates the percentage change in employment by gender in industry *j* ($\text{xemp}_{(s,j)}$) on the basis of cost-minimising demands for employment by industry irrespective of gender ($\text{emp}_{(j)}$) as calculated in the CGE core model. (E17) says that if total employment in industry *j* rises by 5%, then employment of both males and females in industry *j* will rise by 5%. Equation (E18) calculates the measure of employment relevant to determining the gap between gender-specific employment and total employment ($\text{relempgen}_{(s)}$) as the share-weighted sum of the percentage changes in gender-specific employment in each industry ($\text{xemp}_{(s,j)}$). The share weights in (E18) ($\text{SHINDGEN}_{(j,s)}$) describe the share of total economy-wide employment of gender *s* represented by employment of gender *s* in industry *j*.[2] Equation (E19) calculates the percentage change in employment of workers of gender *s* ($\text{empgen}_{(s)}$) using the (E16) framework, with empnat describing the percentage change in national employment (irrespective of gender) as calculated in the CGE core model, and $\text{SHGEN}_{(k)}$ describing gender *k*'s share in total employment.

2.7 Model closure

As discussed in Section 3, we simulate the effects of: (i) an increase in financial capital supply to the Indian economy; and (ii) an increase in the efficiency of new capital formation. We do this under a model closure in which:

(1) Labour markets are characterised by short-run stickiness of the real wage with endogenous unemployment rates, transitioning to a long-run environment in which real wages are endogenous and unemployment rates return to baseline.

(2) Capital and investment is specific to each industry. Capital stocks are sticky in the short-run, but adjust gradually in response to changes in investment. Annual investment in each industry is positively related to the ratio of actual to required rates of return. A policy shock can cause these ratios to depart temporarily from their baseline values in the short-run, but they are gradually returned to baseline via the process of investment and capital formation.

(3) The economy-wide average propensity to consume out of gross national product is exogenous.

(4) The ratio of real private consumption to real public consumption is exogenous.

(5) Unskilled workers move between agricultural and non-agricultural sectors under an assumption of a fixed relativity between remuneration in agriculture (evaluated on an average product basis) and remuneration outside of agriculture (evaluated on a marginal product basis).

[2] The values for $\text{SHINDGEN}_{(i,s)}$ rely on employment estimates by sex estimated for the 130 sectors of the Indian input-output table (IOTT). The data source was unit level data based on National Sample Survey (NSSO)'s Employment-Unemployment Survey (EUS) for 2011-12. For estimating employment classified by IOTT sector, a suitable concordance between NIC2008 and the 130 sectors of the IOTT was prepared. While directly allocating NIC 5 digits numbers into individual sectors of IOTT, due consideration was also given to one or more NIC codes that are jointly allocated into one or more than one sectors of IOTT. The employment estimates thus computed at the 5 digit NIC code were further scaled using total population weights from Registrar General of India (RGI). The estimated employment at the IOTT 130 sector level was further compared with published estimates provided by ILO.

3 Simulation design

3.1 Introduction

In Section 3 we discuss a number of conceptual and practical matters regarding how we model the expansion of capital supply to Indian financial institutions. We begin by describing the modelling of the baseline forecast (Section 3.2). We then discuss how we implement in the model the capital supply expansion (Section 3.3).

3.2 Inputs to the baseline forecast

As described in detail in Dixon and Rimmer (2002), the baseline forecast is constructed through two simulations. In the first simulation, certain structural variables (like economy-wide primary factor technical change), that are otherwise naturally exogenous, are moved instead to the set of endogenous variables. This supports the exogenous determination of certain variables (like real GDP), that are otherwise naturally endogenous. This closure allows the modeller to impose on the baseline outside forecasts or official outcomes for certain key variables (like real GDP). The first simulation reveals the movements in structural variables (like primary factor technical change) that are required to allow the model to reproduce independent forecasts for key variables of interest (like real GDP). The second simulation returns the model to its more natural closure (that is, one in which structural variables (like primary factor technical change) are again exogenous), and all exogenous variables are shocked equal to their values in the first simulation. This allows the second simulation to endogenously reproduce the desired values for key variables of interest (like real GDP), while also establishing a natural closure for the counterfactual simulation, that is, a closure in which structural and policy variables are exogenous, and macroeconomic variables and commodity and industry variables relating to prices and quantities are endogenous.

As discussed in Section 2.3, NV-DYN's initial solution is for 2016. Our baseline simulation therefore covers the period 2017-2030. Because the period to 2018 is known, we are able to impose actual values in the baseline for movements in real GDP, real investment, real private consumption spending, real public consumption spending, import volumes, export volumes, the working age population, population in total, the consumer price index, and the terms of trade. In particular, for real GDP and the consumer price index, we use IMF (2019), and for the remaining variables, we use World Bank (2019). Moving beyond 2018, we enter the realm of forecasting, so actual values are unknown. This narrows the range of variables for which we impose outside estimates. Up to 2023, we impose forecast values for real GDP, real investment, and the consumer price index (using forecasts from IMF (2019) and employment and population projections from the World Bank).[3] Over 2024-30, we: impose forecast values for real GDP based on the trend evident in the IMF forecasts for the earlier period, set the consumer price index growth rate at 4% p.a., and set growth rates for employment and population based on World Bank projections.

In imposing forecasts on the model, we follow the closure rules outlined in Dixon and Rimmer (2002). For certain variables, those that are naturally exogenous, no closure changes are required. These variables cover population, employment, the consumer price index, and real public consumption spending. The remaining variables (real GDP, real private consumption spending, real investment, import volumes, export volumes, and the terms of trade) are naturally endogenous. In order to impose independent values upon them, they must be determined exogenously. As described in Dixon and Rimmer (2002), this requires that the values for relevant structural variables associated with each of these variables be determined endogenously. In particular, we determine endogenously: primary factor technical change, the propensity to consume out of GNP, required rates of return, the preference for imported and domestic varieties of each commodity, and foreign willingness to pay for Indian exports. The endogenous determination of these variables support the exogenous determination of real GDP, real consumption, real investment, import volumes, and export volumes.

3.3 Modelling the sectoral distribution of an additional $US 10 b. of lending by Indian financial institutions

We assume that the additional $US 10 b. of financial capital is distributed across Indian industries in the same proportion as the sectoral composition of lending by the financial institution investees of a major supplier of international capital (Table 9).

In our simulation, we assume that 1/5th of the value of the $US 10 b. of additional lending is added to the Indian economy each year for the five years 2018-22. To do this, we lower industry-specific required rates of return on capital in each industry by an amount sufficient to expand industry-specific investment by values corresponding to supply of 1/5th of the additional $US 10 b. of financial capital supplied to Indian financial institutions, distributed across sectors in proportion to the shares in Table 9. At the end of the 5th year, required rates of return on industry specific investment are adjusted back up by an amount consistent with an end to the five year phase-in period for the additional $US 10 b. of financial capital. The investment supply has two effects. First, it raises investment and capital

[3] http://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections.

formation. The effects of this are discussed in Section 4.1. Second, it potentially improves the efficiency of capital formation. The effects of this are discussed in Section 4.2.

4 Results

4.1 Simulation 1: investment supply

Figure 1 reports deviations in India's real investment and capital stock. As discussed in Section 3.3, we explore the effects of phasing-in an additional $US 10 b. (or approximately ₹ 679 b) of additional investment in five equal tranches over 2018-2022. This accounts for the pattern of peak and decline in the deviation path for Indian investment in Figure 1. The 2018 value of investment in NV-DYN is ₹ 52,175 b. Supply of 1/5th of ₹ 679 b. of additional investment each year (approximately ₹ 136 b. p.a.) represents a positive deviation in aggregate Indian investment of approximately 0.26 per cent. The magnitude of the Indian investment deviation in Figure 1 is somewhat larger than this (at approximately 0.35 per cent), because the investment supply process generates a positive employment deviation (see Figure 3, discussed below), which raises rates of return and causes a generalised expansion of investment beyond that related directly to the injection of new investment funds. By the end of the investment phase-in period, the positive deviation in Indian investment has generated a positive deviation in India's capital stock of approximately 0.16 per cent (Figure 1). Following the investment phase-in period, capital growth rates in each sector return close to their baseline values. At the level of the macro-economy, this will be expressed by the investment deviation lying close to the capital deviation from 2023 onwards. We see this pattern observed in Figure 1, but also note that the investment deviation lies somewhat below the capital deviation. This reflects changes in the composition of industrial activity across industries with different investment / capital ratios, with the supply of new financial capital causing relatively larger positive deviations in sectors with lower than average investment / capital ratios.

Figure 2 reports deviations in the expenditure-side components of GDP (excluding investment, which is reported in Figure 1), the real exchange rate, and the terms of trade. Over the five-year investment phase-in period, the positive deviation in real investment (Figure 1) causes the real GNE deviation to lie above the real GDP deviation. This requires the real balance of trade to move towards deficit, requiring real exchange rate appreciation (Figure 2).[4] The resulting negative deviation in export volumes necessarily means a movement "up" foreign export demand schedules. That is, for export volumes to contract relative to baseline, foreign currency export prices must rise relative to baseline. Hence, the terms of trade must rise relative to baseline over the investment phase-in period. Together

[4] We define the real exchange rate as the local currency c.i.f. import price index divided by the local currency GDP price deflator.

with the positive deviation in real GDP, the terms of trade deviation generates a positive deviation in real private and public consumption spending. This reaches a high of 0.082 per cent in 2022, before falling to 0.035 per cent by the end of the simulation period.

Figure 3 reports deviations in employment measured two ways: in hours, and in hours weighted by hourly wage rates. The first concept is relevant to measuring the economy's labour resource constraint. As discussed in Section 2.4, in the policy simulation we allow employment (hours) of skilled and unskilled workers to deviate temporarily from baseline values under an assumption of transitory sticky wages for skilled and unskilled labour. In the long-run, we assume that wage adjustment forces skilled and unskilled employment (measured in hours) to return to baseline. In Figure 3, this accounts for the gradual return of employment (hours) to baseline. Wage-weighted employment, the second series reported in Figure 3, is relevant to measuring the GDP consequences of changes in aggregate employment and the allocation of labour across sectors. It is clear that the deviation path for employment (wage-weighted) follows the same pattern of trough and recovery as the deviation path for employment (hours). This indicates that the operation of the sticky wage mechanism is the primary influence on the path of employment (wage-weighted). However, it is also clear that the deviation path for employment (wage-weighted) lies above that for employment (hours). This indicates that the operation of the surplus labour mechanism is exerting a secondary influence on the labour market, generating a permanent positive deviation in the concept of employment (that is, wage-weighted hours of employment) that is relevant to determining the GDP consequences of the shock. The fact that employment (wage-weighted) lies above employment (hours) indicates that, compared with baseline, the policy shock is generating an outflow of unskilled labour from the agricultural sector, where its marginal product is lower than in other sectors of the economy.

In the policy simulation, we activate the surplus labour theory by allowing unskilled labour to move between agricultural and non-agricultural activities under an assumption of a fixed relativity between remuneration available within and outside of agriculture. As described in Section 2.5, remuneration within agriculture includes a share of agricultural land rents. Figure 4 reports the percentage deviations in employment of unskilled labour within and outside of agriculture. As is clear from Figure 4, the phasing-in of the new investment investment generates a fall in the share of unskilled labour that is employed in agriculture. Because the marginal product of unskilled labour in agriculture is lower than outside of agriculture, this causes a rise in employment (wage-weighted) relative to employment (hours) (see Figure 3). This effect is most pronounced during the five years in which investment is phased in, during which investment (and thus *construction* activity and employment) are particularly elevated relative to baseline, but persists in the long-run, albeit at an attenuated level.

Figure 5 reports deviations in selected macroeconomic variables relevant to the determination of real GDP. As discussed in reference to Figure 1, the supply of $US 10 b. of additional financial capital to

Indian financial institutions generates a positive deviation in aggregate investment of approximately 0.34 per cent in each of the five years of the investment phase-in period. This accounts for the positive deviation in the economy-wide capital stock, which is 0.14 per cent above baseline by the end of the simulation period. As discussed with reference to Figure 4, the rise in supply of funds to Indian financial institutions causes a transitory positive deviation in employment (hours) and a permanent increase in employment (wage-weighted). The deviation path for the latter variable, which is the relevant employment concept for understanding the GDP deviation, is reproduced in Figure 5. With both employment (wage-weighted) and the capital stock above baseline, so too is the real GDP deviation. The highest point in the real GDP deviation is reached in 2022, at 0.07 per cent. The real GDP deviation then falls somewhat, reflecting the gradual return of employment towards baseline. By the end of the simulation period real GDP is 0.03 per cent above baseline.

We aggregate the deviations in the outputs of each of the model's 150 industries to outcomes for the 16 broad sectors identified in Table 9. Deviations in output for these sectors are reported in Figure 6-Figure 8, distinguished by their 2030 output deviation ranking. Among the sectors with the highest 2030 output deviations are *light manufacturing*, *construction*, and *utilities* (Figure 6). This is consistent with the relative importance of the supply of financial capital by the financial institution investees to these sectors (see final column of Table 9, rows 5, 7 and 9). Note however that both *communications* and *financial services* are also among the top five ranked sectors in Figure 6, despite being relatively less reliant on financial capital by the financial institution investees (see final column of Table 9, rows 13 and 14). This reflects the capital intensity of these sectors. For *communications* and *financial services*, the capital shares in factor returns in NV-DYN are 72% and 76% (for India as a whole, the capital and land share in factor returns is 47%). The high capital intensity of these sectors renders their output more sensitive to an expansion in the supply of financial capital than is suggested by inspection alone of the investee share of sector investment reported in Table 9.

Figure 7 reports output deviations for the five bottom-ranked sectors by 2030 output deviation. Land resources are an important input to two of these sectors (*agricultural crops*, and *livestock*). Because we assume land supply is unaffected by the shock, this places something of a ceiling on the output deviations for these sectors. The *public services* sector, which also appears among the bottom-ranked sectors in Figure 7, subsumes industries like public administration, education, social services, and medical services. These industries are characterised by high government sales shares. This renders the output of these industries highly correlated with the private and public consumption deviation, which, as reported in Figure 2, is close to the real GDP deviation. Hence, the output deviation for the public services sector tracks the real GDP deviation. Both the business services and textiles sectors are trade-exposed via export sales. Hence, both sectors are adversely affected by real appreciation. This is particularly apparent during the investment phase-in period, when the deviation in the real exchange rate is at its largest, but as reported in Figure 2, a small real appreciation persists in the long-run.

Figure 8 reports output deviations for the middle six sectors as ranked by 2030 output deviations. Consistent with these sectors being middle-ranked, their output deviations tend to cluster around and track the real GDP deviation (Figure 5). Two of these sectors, *trade* and *transport*, are important providers of margin services. Since these services facilitate transactions by producers, investors, households, government, exporters and importers, it is natural that the deviations in the output of the industries producing these services correlates with a summary measure of overall economic activity like real GDP. For *forestry and fishing*, and *mineral extraction*, inputs of natural resources are assumed to be in fixed supply, which limits the potential for expansion in the output of these sectors in response to the expansion in the supply of capital to Indian financial institutions, although neither sector is a particularly highly-ranked beneficiary of this funding (see final column of Table 9, rows 3 and 4). Similarly, *heavy manufacturing* is one of the lowest ranked recipients of financial investee funding in terms of proportion of sectoral investment (see final column of Table 9, row 8), but the industries subsumed within this sector are capital intensive, rendering them sensitive to supply of financial capital. The presence of *food processing* among middle-ranked sectors is perhaps surprising, given that it has the highest ratio of financial investee funding to investment of any sector in Table 9 (see row 5). Two factors damp the responsiveness of food processing to an expansion in the supply of financial capital to the Indian economy. First, inputs of unprocessed agricultural products are important intermediate inputs to these sectors. Because land is in fixed supply to the upstream industries producing agricultural products, part of the adjustment from expansionary pressures in the *food processing* sector is borne by increased farmland rents. Second, a high share of food processing output is sold to the household sector, and the own-price elasticity of demand for agricultural products is relatively low. This allows the *food processing* sector to pass on to households through lower prices part of the capital input cost benefits created by an expansion in capital supply.

Figure 9 reports deviations in employment by sex, using the top-down method described in Section 2.6. Broadly, the employment deviations for males and females follows the same pattern of peak and recovery as the aggregate employment path reported in Figure 4. It is also clear that the deviation in male employment lies above the deviation in female employment. This reflects differences in male / female employment ratios across sectors. In the peak job gain years (2018-22), the sectors experiencing the largest positive deviations in activity (*construction, forestry and fishing, light manufacturing, utilities*, and *trade* – see Figure 6 and Figure 8) also have above-average male employment shares (83%, compared to an economy-wide average of 73%). At the same time, the *textiles* sector, which is among the sectors experiencing a strong negative deviation in activity over this period, has an above-average female employment share (40%, compared to an economy-wide average of 27%). The positive correlation between sectoral output deviations and sectoral male employment shares accounts for why the male employment deviation lies above the aggregate employment deviation in Figure 9.

Figure 10 reports impacts on the returns to labour, capital and land. While NV-DYN does not contain an income distribution module, the factor price impacts reported in Figure 10 nevertheless provide insights into potential income distributional impacts. This is because ownership of capital and land tends to be concentrated in high income and net worth households, while returns to labour tend to be more important for middle and low income and net-worth households. By reducing capital scarcity relative to baseline, increasing the supply of capital to Indian financial institutions causes capital rental prices to fall relative to baseline. At the same time, this lowers the labour / capital and land / capital ratios, causing returns to labour and land to rise relative to baseline.

4.2 Simulation 2: investment productivity

In this simulation, we explore the potential consequences of engagement activities between Indian financial institutions and foreign capital providers raising the efficiency of local capital formation. We investigate the effects of each $1 of capital formation funded by the simulated $US 10 b. increase in financial capital requiring 5% fewer resources than $1 of capital formation funded from other sources. The hypothesis underlying this simulation is that some elements of the nature of the engagement between Indian financial institutions and selected foreign funders (via board positions, work on compliance issues, and staying with a bank for longer than a typical commercial shareholder might) have the potential to bring additional benefits, such as reducing bad debts and improving the efficiency of capital allocation. We represent these benefits as a higher level of capital formation efficiency for the investment funded by the additional $US 10 b. of financial capital. Our 5% shock is illustrative, but the results from the simulation can be scaled in future if relevant information on the magnitude of these benefits were to be assembled.

As discussed in Section 4.1 in the context of Figure 1, the supply of an additional $US 10 b. of financial capital over the five year phase in period (approximately ₹ 136 b. p.a.) causes a positive deviation in aggregate Indian investment of approximately 0.26 per cent over the period. In our productivity simulation, this raises the efficiency of Indian capital formation by approximately 0.013 per cent (=0.26*0.05) relative to baseline (reported in Figure 11 as a fall in input requirements per unit of physical capital formation). This lowers the cost of capital formation over the period 2018-22, raising rates of return on capital and thus raising real investment relative to baseline (Figure 11). The magnitude of the rise in investment expenditure is less than the magnitude of the fall in input requirements per unit of investment. As a result, there is a net negative deviation in output of the *construction* sector (used chiefly for capital formation) over the investment phase-in period (Figure 11). Put another way, the aforementioned improvement in capital formation efficiency is greater than the negative deviation in *construction* activity, ensuring a net positive deviation in real gross fixed capital formation.

We would normally expect an improvement in productivity to generate a short-run positive deviation in employment. However, we see in Figure 12 that there is a small negative employment deviation in the first year of the simulation, before employment rises slightly above baseline, and then begins a gradual return to baseline. The brief negative deviation in short-run employment reflects the labour intensity of the *construction* sector, which as discussed above, experiences a negative deviation in output as a result of the improvement in the efficiency of capital formation.

The positive capital deviation grows steadily over 2019-23 (Figure 12). This reflects the positive deviation in investment and the improvement in investment efficiency over the period 2018-22, which affects functional capital supply with a one-year lag. The end of the investment efficiency improvement period in 2023 sees the rate of capital growth wanting to return to its baseline path, albeit from a now larger capital stock relative to baseline from 2023. This explains the persistent positive deviation in the investment deviation from 2023. Because the improvement to investment efficiency is transitory, there is some overshooting in the positive capital deviation by 2023. This explains the partial adjustment towards baseline of the capital stock deviation from 2023.

The real GDP deviation lies above the deviations in both capital and labour over the first five years of the simulation because of the improvement in the efficiency of capital formation over this period (Figure 11). This raises output per unit of input in capital formation, which manifests at the economy-wide level as a larger positive deviation in real GDP than the positive deviations in inputs of labour and capital would otherwise explain. Capital formation efficiency returns to baseline from 2023 onwards (Figure 11). Hence, in Figure 12, we see that from 2023 onwards the deviations in inputs of employment and capital fully explain the deviation in real GDP (that is, the real GDP deviation lies between the capital and employment deviations).

Figure 13 reports deviations in a number of macroeconomic price indices that are relevant to determining the movement in real consumption. As discussed in Section 2.4, national consumption spending is determined as a fixed proportion of gross national product. That is:

$$P_C C = \Phi (P_Y Y - NFL \times R) \qquad \text{(E16)}$$

where C is real consumption (private and public), Y is real GDP, NFL is net foreign liabilities, R is the average interest rate on net foreign liabilities, and P_C and P_Y are price indices for consumption and GDP. Rearranging for C provides:

$$C = \Phi (P_Y / P_C \ Y - NFLR \times R) \qquad \text{(E17)}$$

where NFLR is real (consumption price deflated) net foreign liabilities. This approximates to:

$$C \approx \Phi \left(\left(\frac{P_X}{P_M} \right)^{S_T} \cdot \left(\frac{P_I}{P_C} \right)^{S_I} \cdot Y \; - NFLR \times R \right) \qquad \text{(E18)}$$

where P_X, P_M and P_I are price indices for exports, imports and investment respectively, S_T is the share of trade in GDP (an average of the export and import shares in GDP; approximately 0.20), and S_I is the share of investment in GDP (approximately 0.31). This equation makes clear that, for a given level of real GDP and net foreign liability payment obligations, real consumption is positively related to two relative price terms. The first is the terms of trade (P_X/P_M), and the second is the relative price of investment and consumption (P_I/P_C). The second term arises from the assumption of a fixed nominal consumption share in national income. Under this rule, with given real GDP, a fall in the consumption price relative to the investment price must raise real consumption. Figure 13 reports the deviations in P_X, P_M, P_I and P_C. The investment price index (P_I) has a negative deviation over 2018-2022. This mirrors the fall in inputs required per unit of investment (Figure 11), because the price of a unit of investment must fall to reflect the saving in input requirements. This represents a rise in the price of consumption relative to the price of investment (Figure 13).

A rise in the relative price of consumption acts to damp real consumption relative to movements in real GDP, as can be seen in the consumption equation above. This largely explains why the real consumption deviation lies below the real GDP deviation over 2018-22 (Figure 14). The fall in consumption relative to GDP causes the real balance of trade to move towards surplus. In Figure 14, we see this is manifested as a small negative deviation in import volumes and a positive deviation in export volumes. The movement towards balance of trade surplus is facilitated by depreciation of the real exchange rate (the deviation in the real depreciation variable is positive). The positive deviation in export volumes requires a fall in the foreign currency prices of India's exports (that is, it requires a movement down India's foreign export demand schedules). This explains the negative deviation in the terms of trade over 2018-22 (Figure 14). As is clear from the consumption equation above, this also acts to damp real consumption relative to real GDP.

From 2023 onwards, the price indices for investment, consumption, exports and imports return to baseline levels (Figure 13). However the stimulus to capital formation over 2018-22 (Figure 11) generates a positive deviation in the capital stock over 2023-30 (Figure 12). This causes a positive deviation in real GDP over 2023-30 (Figure 14). This contributes to a positive deviation in real consumption over 2023-30, although the consumption deviation lies below the real GDP deviation, because the positive deviation in investment over 2018-23 means that India's foreign liability servicing costs are higher than baseline over 2018-30.

Output deviations for 16 broad sectors are reported in Figure 15, Figure 16 and Figure 17, ranked by 2030 output deviation. There is some correlation between the sectoral rankings in the investment simulation discussed in Section 4.1 (reported in Figure 6 - Figure 8) and the sectoral output deviation rankings reported in Figure 15 - Figure 17 (the correlation coefficient between the two rankings is 0.58), hence we confine our discussion of sectoral results to the sectors with relatively large movements in their rankings between the two simulations. The correlation between the rankings reflects the linking of the size of the investment efficiency improvement to the value of the investment funding by the financial institution investees (see Table 9). The rankings are most similar for the top-ranked sectors (Figure 15). Three of the top-ranked sectors (*light manufacturing*, *financial services*, and *communications*) were also top-ranked in the investment supply simulation. Financial capital supply by the financial institution investees is relatively important to the *light manufacturing* sector (see final column of Table 9, rows 5, 7 and 9), and thus the capital formation efficiency differential attached to the additional $US 10 b. of financial capital is relatively more consequential for this sector. Again, as discussed in Section 4.1, *communications* and *financial services* are relatively capital intensive, which renders their output more sensitive to the improvement of capital formation efficiency than would be suggested by inspection of the investee share of sector investment reported in Table 9. *Utilities*, which is among the top-five ranked sectors in the investment supply simulation (see Section 4.1), is also highly-ranked in the productivity simulation (it is the highest ranked sector in Figure 17, which reports the six middle-ranked sectors by 2030 output deviation). However, *construction*, which was in the five top-ranked sectors in the investment supply simulation, is among the five bottom-ranked sectors in the productivity simulation (Figure 16). As discussed earlier in the context of Figure 11, part of the response to an improvement in investment efficiency is a compensating decrease in use of inputs to investment (like *construction* output). This places the *construction* sector among the bottom-ranked sectors. It also explains the presence of heavy *manufacturing* among the bottom-ranked sectors in Figure 16. Like *construction*, *heavy manufacturing* is also an important input to capital formation. However its output deviation (unlike that of *construction*) is sensitive to the real depreciation of the exchange rate during the investment supply period (see Figure 14) because of its exposure to international trade (approximately 12% of *heavy manufacturing* output is exported, and 22% of domestic use of *heavy manufacturing* is satisfied by imports).

The two remaining sectors in the five top-ranked sectors are *business services* and *food processing*. These were ranked among the bottom five and middle six respectively in the investment simulation (see Section 4.1). The change in the 2030 ranking of *business services* reflects the extent of recovery from differences in the short-run adjustment paths of this trade-exposed sector in the two simulations. In the investment simulation, the real exchange rate appreciates in the short-run, which causes a negative short-run deviation in output of this sector, followed by gradual adjustment towards baseline in the latter half of the simulation (Figure 7). In the productivity simulation, the real exchange rate depreciates in the short-run (Figure 14), which causes a short-run positive deviation in the output of trade-exposed sectors like *business services*, followed by gradual return to baseline in the latter half of the simulation (Figure 15).

Two of the remaining five bottom-ranked sectors (*textiles* and *agricultural crops*) were also among the bottom-ranked sectors in the investment simulation. Sales to private consumption spending are important to both sectors, and thus the damping of the real consumption deviation relative to real GDP (Figure 14) lowers the position of both sectors in the sectoral output ranking. As discussed in Section 4.1, the fixity of land inputs to the industries within the *agricultural crops* sector also constrains the potential positive output deviation for this sector.

Figure 18 reports deviations in employment by sex, using the top-down method described in Section 2.6. The employment deviations for males and females track closely together. Nevertheless, the productivity effects favour female employment relative to male employment (the simulated productivity benefits cause the female employment deviation to lie above the male employment deviation). This reflects differences in male / female employment ratios across sectors. In particular, over the productivity improvement period (2018-22), the four sectors experiencing the lowest output deviations (*trade, financial services, forestry and fishing*, and *construction* – see Figure 15, Figure 16, and Figure 17) all have above-average male employment shares (83%, as compared to the economy-wide average of 73%). At the same time, among the more favourably affected sectors during the productivity gain period is *textiles* (see Figure 16), which has a female employment share of 40% (compared to an economy-wide average of 27%).

Figure 19 reports deviations in factor prices. This is useful as a broad indicator of the potential income distributional effects arising from the efficiency-enhancing elements of engagement activities between Indian financial institutions and capital suppliers. As discussed in the context of Figure 12, this has the effect of increasing capital supply relative to baseline. The resulting expansion in capital supply relative to labour and land supply pushes down capital rental prices relative to baseline (Figure 19). While NV-DYN does not have an income distributional module, it is nevertheless likely that this capital price effect would hurt high income and high net worth households, given that capital ownership tends to be concentrated among such households. At the same time, we see in Figure 19 that returns to workers and farm owners increase relative to baseline. While the effects of land rental price increases might have an ambiguous effect on income distribution, the relative rise in the wage index would likely have a favourable effect on measures of income distribution, given the importance of returns from labour for low and middle-income households.

5 Concluding remarks

The modelling undertaken for this report could be extended in a number of directions in future work.

The first is in exploring further details on how the lending activities of India's financial institutions connect with a more finely detailed industrial classification. The NV-DYN model contains 150 industries. At sixteen sectors, while aggregated relative to NV-DYN's classification, the data classification provided in Table 9 contains a useful level of industrial detail. Nevertheless, the opportunity remains for a more detailed mapping to the many industries in NV-DYN in future, which would allow reporting of the impacts of expanding financial capital supply to Indian financial institutions at a finer level of industrial disaggregation.

The second is regional detail. NV-DYN is a single country model. It could be provided regional detail in either of two ways. One would be via the addition to NV-DYN of a top-down facility for translating national results to regional results (see for example, Dixon and Rimmer 2004). The second would be via the creation of a new fully bottom-up multi-regional model of India (see for example, Wittwer 2017). Such models would facilitate investigation of the impacts of increasing the supply of financial capital on measures of economic activity (like regional gross product, regional consumption, regional investment, regional employment, industrial output by region, and so forth) for regions of policy interest (like states and union territories). This would elucidate how the activities of expanding financial capital supply to Indian financial institutions can contribute to India's regional development priorities.

The third is income distributional detail. This can be done either by building many more households (spanning households with different social, demographic and economic characteristics) directly into NV-DYN, or by developing a stand-alone income distributional model (like a micro-simulation model) containing many households. NV-DYN provides outputs for changes in factor prices (wage rates, rental rates on capital and natural resources like agricultural land) and household purchaser's prices for 150 commodities. It thus produces outputs that figure prominently in the determination of household income and household living expenses. By passing these outputs through a multi-household model, we can explore how an increase in financial capital supply to Indian financial institutions affects the distribution of expenditure and income, and economic prospects for different types of household. In our current application, we already noted that an expansion in financial capital supply possibly exerts a favourable impact on income distribution, by lowering capital rental prices, and by raising returns to labour and land. With a fully-specified income distributional model, a more nuanced story could be told about prospects for different types of households with varying degrees of reliance on wage, capital and land income from different occupations, industries and regions.

The fourth is informality in the labour market. In this paper, we have applied the Lewis mechanism to unskilled workers in agriculture. A central element of this mechanism is average product remuneration in the agricultural sector. For this sector, both the presence of family-run operations, and the scope for a significant share of economic returns to accrue to land and capital owners, make average product remuneration a plausible conjecture. In future work, the possibility that informality exists in other sectors could be explored. It is questionable however, whether this would materially affect the macroeconomic results presented in this paper. For the macro results, it matters little whether the increase in effective employment comes from low marginal product rural workers or low marginal product urban workers. The important mechanism is turning lower marginal product workers wherever they come from into higher marginal product workers in formal employment.

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Table 1. Expanding capital supply to Indian financial institutions over 2018-22: impacts on selected macroeconomic variables (₹ billion deviation from baseline, unless otherwise indicated)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Ave.
1. Real GDP (₹ b.)	0	55	92	125	153	178	159	150	145	142	141	141	141	142	136
2. Real investment (₹ b.)	0	174	189	201	211	220	74	73	74	76	78	82	85	89	125
3. Real private consumption (₹ b.)	0	54	69	85	100	113	87	84	83	82	83	83	84	85	84
4. Real exports (₹ b.)	0	-120	-113	-106	-101	-97	20	15	11	8	4	1	-1	-4	-37
5. Real public consumption (₹ b.)	0	10	13	16	19	22	17	16	16	16	16	16	16	16	16
6. Real import volumes (₹ b.)	0	63	67	71	76	81	39	39	39	39	40	41	42	43	52
7. Male employment ('000s)	0	184	208	216	210	195	101	54	30	19	12	9	8	7	96
8. Female employment ('000s)	0	23	34	38	36	31	16	9	5	3	2	1	0	0	15
9. Total employment ('000s)	0	207	242	254	246	226	117	63	35	21	14	10	8	7	112

Table 2. Expanding capital supply to Indian financial institutions over 2018-22: impacts on industry employment ('000 person deviation from baseline)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Agricultural crops	0.0	-59.3	-33.7	-22.8	-23.5	-31.5	22.4	-7.6	-23.6	-32.0	-36.7	-39.4	-40.7	-41.6
2. Livestock	0.0	3.1	4.4	4.9	4.6	3.8	3.4	1.2	0.0	-0.6	-0.9	-1.1	-1.2	-1.2
3. Forestry and fisheries	0.0	1.3	1.4	1.5	1.4	1.3	0.7	0.4	0.3	0.2	0.2	0.1	0.1	0.1
4. Mineral extraction	0.0	-2.4	-1.8	-1.5	-1.3	-1.2	0.3	0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
5. Food processing	0.0	0.4	-2.8	-4.7	-6.0	-6.9	-7.2	-6.3	-5.6	-4.9	-4.4	-4.0	-3.6	-3.3
6. Textiles	0.0	-47.7	-40.2	-36.1	-34.1	-33.3	-3.6	-7.0	-8.9	-9.9	-10.6	-10.9	-11.1	-11.2
7. Light manufacturing	0.0	0.9	2.9	4.2	5.1	5.7	6.1	5.1	4.7	4.5	4.5	4.5	4.5	4.6
8. Heavy manufacturing	0.0	19.9	17.5	16.4	15.3	14.0	4.9	3.3	2.6	2.3	2.3	2.2	2.2	2.2
9. Utilities	0.0	0.9	0.0	-0.6	-1.0	-1.2	-1.9	-1.6	-1.3	-1.2	-1.0	-0.9	-0.9	-0.8
10. Construction	0.0	269.0	260.2	252.2	244.6	237.3	57.5	55.2	55.0	55.6	56.5	57.3	58.1	58.8
11. Trade	0.0	26.6	30.3	31.1	29.8	27.4	15.2	9.6	6.7	5.2	4.4	3.9	3.6	3.3
12. Transport	0.0	7.6	9.0	9.8	10.1	9.9	6.3	4.9	4.0	3.6	3.3	3.0	2.9	2.7
13. Communications	0.0	-1.3	-1.0	-0.8	-0.7	-0.7	0.3	0.2	0.1	0.1	0.0	0.0	0.1	0.1
14. Financial services	0.0	1.6	2.0	2.0	2.0	1.8	1.3	0.8	0.6	0.4	0.3	0.3	0.3	0.2
15. Business services	0.0	-14.4	-11.3	-9.4	-8.1	-7.4	2.6	1.0	0.0	-0.7	-1.1	-1.5	-1.7	-1.9
16. Public services	0.0	1.2	5.3	7.4	7.7	6.7	8.6	3.8	0.8	-1.1	-2.4	-3.3	-4.1	-4.6
Total	0.0	207.4	242.3	253.8	245.9	225.7	116.9	62.9	35.3	21.3	14.0	10.1	8.3	7.1

Table 3. Investment efficiency enhancement over 2018-22: impacts on selected macroeconomic variables (₹ billion deviation from baseline, unless otherwise indicated)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Ave.
1. Real GDP (₹ b.)	0	5.6	7.1	8.5	9.8	10.9	3.8	3.4	3.0	2.8	2.6	2.4	2.2	2.1	4.9
2. Real investment (₹ b.)	0	3.5	4.2	4.6	5.0	5.2	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.4	2.0
3. Real private consumption (₹ b.)	0	-1.0	-0.2	0.5	1.1	1.6	2.5	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.3
4. Real exports (₹ b.)	0	2.2	2.4	2.7	3.1	3.5	1.0	0.9	0.7	0.6	0.5	0.5	0.4	0.3	1.4
5. Real public consumption (₹ b.)	0	-0.2	0.0	0.1	0.2	0.3	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
6. Real import volumes (₹ b.)	0	-1.2	-0.8	-0.6	-0.4	-0.3	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.1
7. Male employment ('000s)	0	-3.4	0.1	2.1	3.1	3.4	1.7	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.6
8. Female employment ('000s)	0	-0.4	0.8	1.5	1.8	1.9	1.0	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.6
9. Total employment ('000s)	0	-3.8	0.9	3.6	4.9	5.3	2.7	1.3	0.6	0.3	0.2	0.0	0.0	0.0	1.2

Table 4. Investment efficiency enhancement over 2018-22: impacts on industry employment ('000 person deviation from baseline)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Agricultural crops	0.0	1.1	3.0	4.1	4.6	4.6	0.8	0.3	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
2. Livestock	0.0	-0.1	0.1	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
3. Forestry and fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Mineral extraction	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Food processing	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0
6. Textiles	0.0	0.9	0.9	0.9	0.9	0.9	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
7. Light manufacturing	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8. Heavy manufacturing	0.0	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
9. Utilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. Construction	0.0	-4.9	-3.9	-3.4	-3.1	-3.0	0.5	0.2	0.2	0.1	0.1	0.1	0.0	0.0
11. Trade	0.0	-0.5	0.1	0.4	0.6	0.7	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0
12. Transport	0.0	-0.1	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0
13. Communications	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14. Financial services	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. Business services	0.0	0.3	0.3	0.4	0.5	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0
16. Public services	0.0	0.0	0.3	0.6	0.8	0.8	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.0
Total	0.0	-3.8	0.9	3.6	4.9	5.3	2.7	1.3	0.6	0.3	0.2	0.0	0.0	0.0

Table 5. Expanding capital supply to Indian financial institutions over 2018-22: impacts on selected macroeconomic variables (% deviation from baseline)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Real GDP (at market prices)	0.00	0.03	0.05	0.06	0.07	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03
2. Real private consumption	0.00	0.05	0.06	0.07	0.08	0.08	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.03
3. Real investment	0.00	0.33	0.34	0.35	0.35	0.35	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10
4. Real public consumption	0.00	0.05	0.06	0.07	0.08	0.08	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.03
5. Export volumes	0.00	-0.35	-0.28	-0.24	-0.20	-0.17	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
6. Import volumes	0.00	0.17	0.17	0.17	0.16	0.16	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05
7. Aggregate employment (hours)	0.00	0.04	0.04	0.04	0.04	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8. Aggregate employment (wage-weight	0.00	0.05	0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
9. Real consumer wage	0.00	0.01	0.03	0.06	0.09	0.11	0.12	0.12	0.12	0.11	0.11	0.10	0.09	0.09
10. Capital stock	0.00	0.00	0.04	0.08	0.11	0.14	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14
11. Real devaluation	0.00	-0.19	-0.15	-0.12	-0.10	-0.09	0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
12. Terms of trade	0.00	0.08	0.07	0.05	0.05	0.04	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6. Expanding capital supply to Indian financial institutions over 2018-22: impacts on selected industry variables (% deviation from baseline)

	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
1. Agricultural crops	0.00	-0.01	0.01	0.02	0.03	0.03	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02
2. Livestock	0.00	0.03	0.04	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02
3. Forestry and fisheries	0.00	0.03	0.06	0.07	0.08	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
4. Mineral extraction	0.00	-0.03	-0.01	0.00	0.01	0.02	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
5. Food processing	0.00	-0.01	0.02	0.04	0.05	0.06	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.04
6. Textiles	0.00	-0.12	-0.09	-0.07	-0.06	-0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00
7. Light manufacturing	0.00	-0.02	0.03	0.07	0.10	0.13	0.16	0.15	0.13	0.13	0.12	0.11	0.11	0.10
8. Heavy manufacturing	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
9. Utilities	0.00	0.02	0.05	0.07	0.08	0.09	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.05
10. Construction	0.00	0.28	0.30	0.30	0.31	0.30	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09
11. Trade	0.00	0.02	0.04	0.06	0.07	0.07	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.04
12. Transport	0.00	0.02	0.03	0.05	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.03	0.03	0.03
13. Communications	0.00	-0.02	0.00	0.01	0.02	0.04	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05
14. Financial services	0.00	0.01	0.03	0.05	0.06	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
15. Business services	0.00	-0.14	-0.09	-0.05	-0.03	-0.01	0.09	0.07	0.05	0.04	0.03	0.03	0.02	0.02
16. Public services	0.00	0.04	0.05	0.05	0.06	0.06	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02

Table 7. Investment efficiency enhancement over 2018-22: impacts on selected macroeconomic variables (% deviation from baseline)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Real GDP (at market prices)	0.0000	0.0032	0.0040	0.0045	0.0049	0.0052	0.0022	0.0019	0.0017	0.0015	0.0014	0.0013	0.0012	0.0011
2. Real private consumption	0.0000	-0.0010	-0.0002	0.0004	0.0008	0.0012	0.0017	0.0014	0.0012	0.0010	0.0009	0.0008	0.0007	0.0006
3. Real investment	0.0000	0.0065	0.0075	0.0080	0.0083	0.0084	0.0010	0.0007	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005
4. Real public consumption	0.0000	-0.0010	-0.0002	0.0004	0.0008	0.0012	0.0017	0.0014	0.0012	0.0010	0.0009	0.0008	0.0007	0.0006
5. Export volumes	0.0000	0.0063	0.0059	0.0061	0.0061	0.0061	0.0016	0.0013	0.0010	0.0008	0.0006	0.0005	0.0004	0.0003
6. Import volumes	0.0000	-0.0031	-0.0021	-0.0015	-0.0010	-0.0006	0.0014	0.0011	0.0009	0.0008	0.0007	0.0006	0.0005	0.0004
7. Aggregate employment (hours)	0.0000	-0.0006	0.0002	0.0006	0.0008	0.0009	0.0004	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
8. Aggregate employment (wage-weight	0.0000	-0.0010	-0.0001	0.0003	0.0006	0.0006	0.0005	0.0003	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000
9. Real consumer wage	0.0000	-0.0001	-0.0002	0.0000	0.0005	0.0011	0.0028	0.0026	0.0024	0.0021	0.0018	0.0016	0.0014	0.0012
10. Capital stock	0.0000	0.0000	0.0008	0.0016	0.0024	0.0030	0.0036	0.0033	0.0030	0.0027	0.0025	0.0023	0.0021	0.0019
11. Real devaluation	0.0000	0.0074	0.0065	0.0060	0.0056	0.0053	-0.0004	-0.0002	-0.0001	0.0001	0.0002	0.0003	0.0004	0.0004
12. Terms of trade	0.0000	-0.0015	-0.0014	-0.0014	-0.0014	-0.0014	-0.0003	-0.0002	-0.0002	-0.0002	-0.0001	-0.0001	-0.0001	-0.0001

Table 8. Investment efficiency enhancement over 2018-22: impacts on selected industry variables (% deviation from baseline)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1. Agricultural crops	0.0000	0.0001	0.0007	0.0010	0.0013	0.0014	0.0010	0.0008	0.0006	0.0005	0.0004	0.0004	0.0003	0.0003
2. Livestock	0.0000	-0.0005	0.0002	0.0007	0.0010	0.0012	0.0012	0.0010	0.0008	0.0006	0.0005	0.0004	0.0004	0.0003
3. Forestry and fisheries	0.0000	-0.0006	0.0001	0.0006	0.0009	0.0011	0.0013	0.0011	0.0009	0.0007	0.0006	0.0005	0.0004	0.0004
4. Mineral extraction	0.0000	0.0005	0.0011	0.0016	0.0019	0.0021	0.0017	0.0014	0.0011	0.0009	0.0007	0.0005	0.0004	0.0003
5. Food processing	0.0000	0.0002	0.0009	0.0015	0.0018	0.0020	0.0017	0.0014	0.0012	0.0010	0.0009	0.0008	0.0007	0.0006
6. Textiles	0.0000	0.0022	0.0029	0.0034	0.0038	0.0040	0.0018	0.0013	0.0009	0.0007	0.0005	0.0004	0.0003	0.0002
7. Light manufacturing	0.0000	0.0003	0.0017	0.0029	0.0037	0.0043	0.0040	0.0033	0.0027	0.0023	0.0020	0.0017	0.0014	0.0012
8. Heavy manufacturing	0.0000	-0.0001	0.0004	0.0008	0.0011	0.0013	0.0010	0.0007	0.0005	0.0004	0.0003	0.0002	0.0002	0.0001
9. Utilities	0.0000	-0.0004	0.0005	0.0012	0.0016	0.0020	0.0021	0.0017	0.0014	0.0012	0.0010	0.0008	0.0007	0.0006
10. Construction	0.0000	-0.0051	-0.0041	-0.0036	-0.0033	-0.0032	0.0008	0.0005	0.0004	0.0003	0.0002	0.0002	0.0002	0.0002
11. Trade	0.0000	-0.0004	0.0002	0.0007	0.0010	0.0013	0.0013	0.0011	0.0009	0.0008	0.0007	0.0006	0.0005	0.0005
12. Transport	0.0000	-0.0003	0.0004	0.0009	0.0012	0.0014	0.0012	0.0009	0.0008	0.0006	0.0005	0.0004	0.0004	0.0003
13. Communications	0.0000	0.0003	0.0011	0.0017	0.0023	0.0027	0.0025	0.0022	0.0019	0.0016	0.0014	0.0013	0.0011	0.0010
14. Financial services	0.0000	-0.0003	0.0002	0.0006	0.0009	0.0012	0.0014	0.0013	0.0012	0.0011	0.0011	0.0010	0.0009	0.0008
15. Business services	0.0000	0.0025	0.0039	0.0051	0.0060	0.0066	0.0041	0.0033	0.0026	0.0021	0.0017	0.0013	0.0011	0.0009
16. Public services	0.0000	-0.0007	0.0001	0.0007	0.0011	0.0013	0.0013	0.0010	0.0008	0.0007	0.0006	0.0005	0.0004	0.0004

Table 9. Sectoral allocation of new investment (in m. US$) and share in NV-DYN 2018 sectoral investment (final column, %)

Sector	2018 (m.US$)	Share in 2018 NV-DYN model investment (%)
1. Agricultural crops	1,098	2.9
2. Livestock	324	2.2
3. Forestry and fisheries	324	1.7
4. Mineral extraction	339	1.4
5. Food processing	528	5.8
6. Textiles	258	1.8
7. Light manufacturing	957	3.7
8. Heavy manufacturing	566	0.6
9. Utilities	550	2.9
10. Construction	651	2.4
11. Trade	1,306	0.7
12. Transport	555	1.3
13. Communications	181	0.9
14. Financial services	895	0.6
15. Business services	875	3.1
16. Public services	592	1.4
Total	10,000	1.3

Figure 1: Aggregate investment, capital stock and construction sector output (% dev'n from baseline)

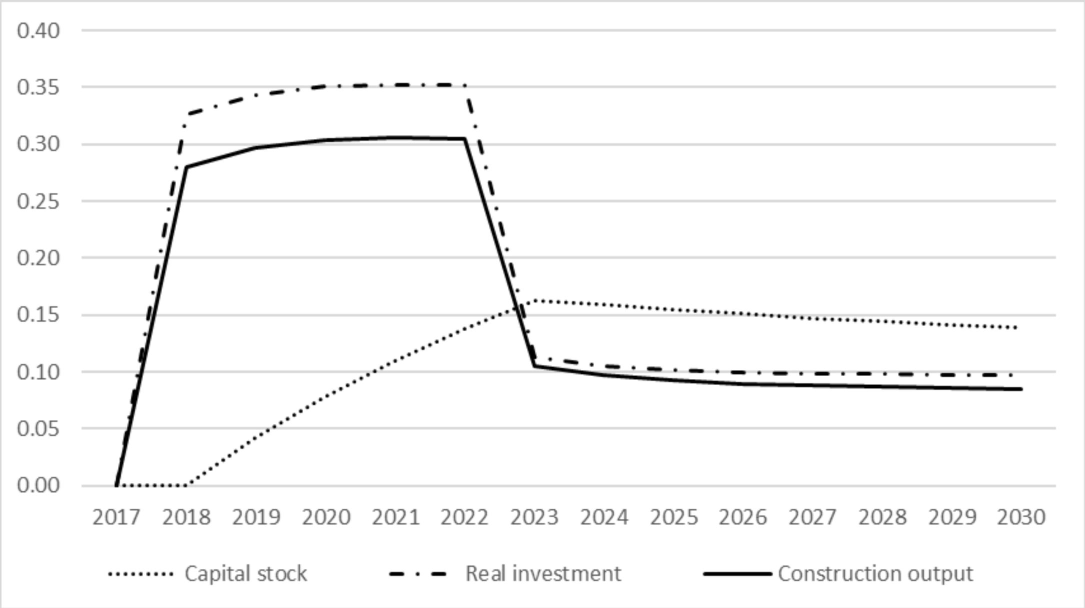

Figure 2: Expenditure-side components of real GDP, real exchange rate, and the terms of trade (% dev'n from baseline)

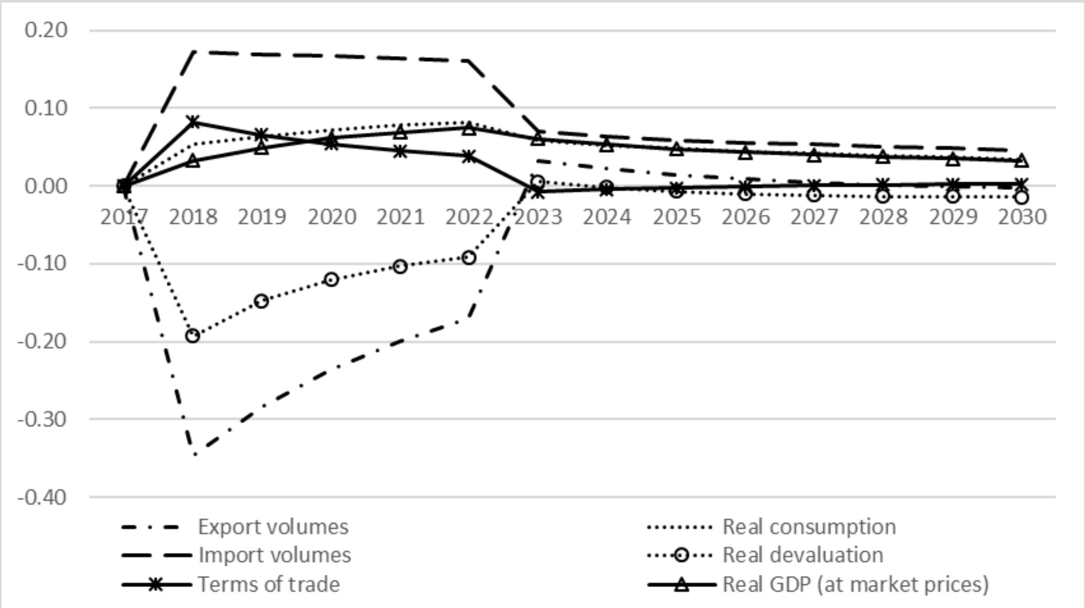

Figure 3: Employment (wage bill weighted and hours) (% dev'n from baseline)

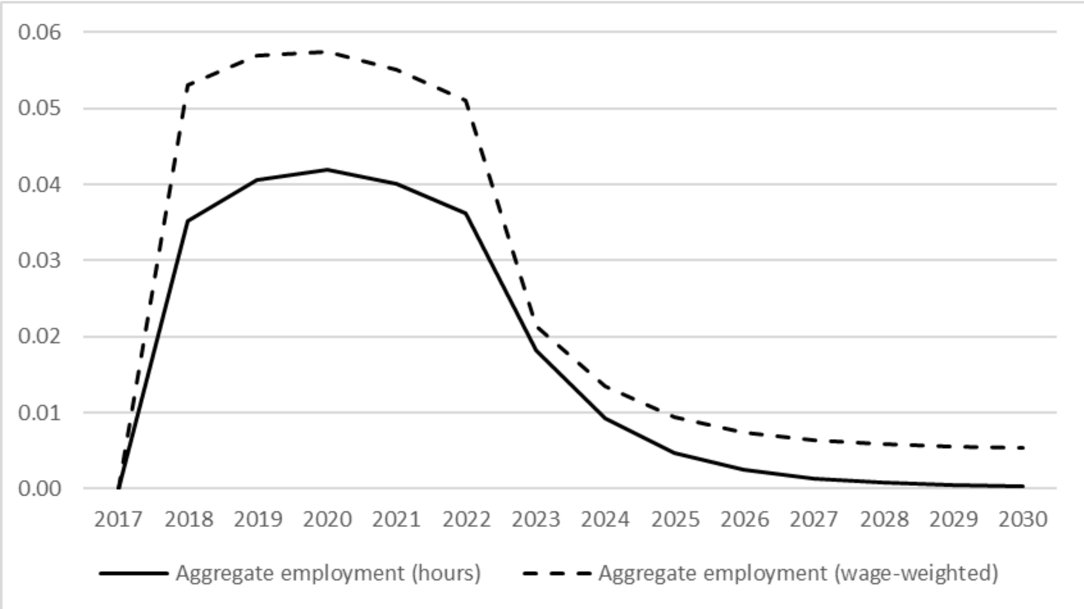

Figure 4: Employment (hours) of unskilled labour within and outside agriculture (% dev'n from baseline)

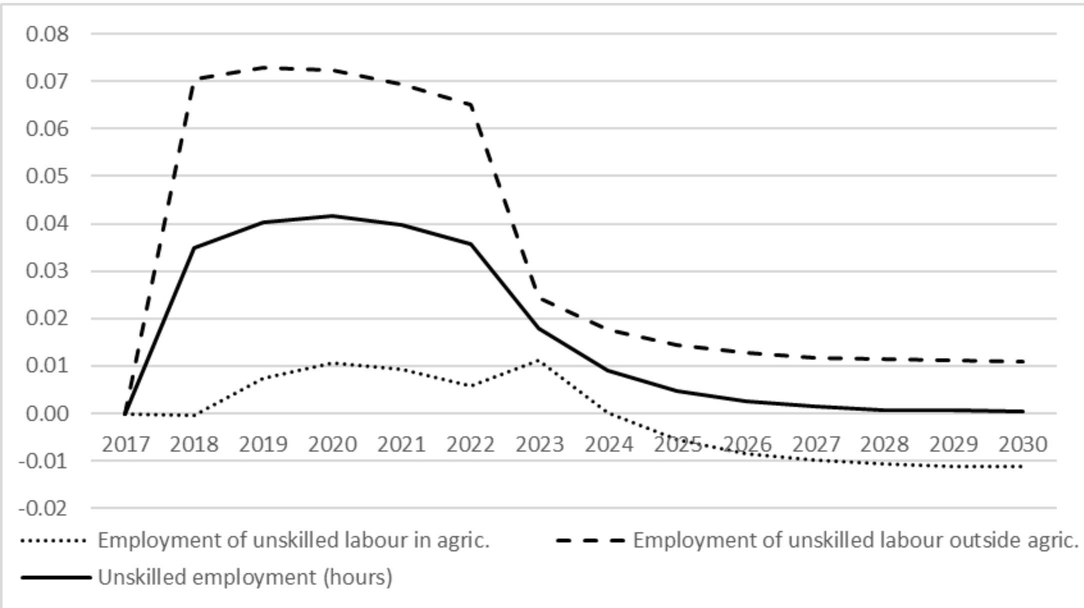

Figure 5: Capital stock, employment, real wage, and real GDP (% dev'n from baseline)

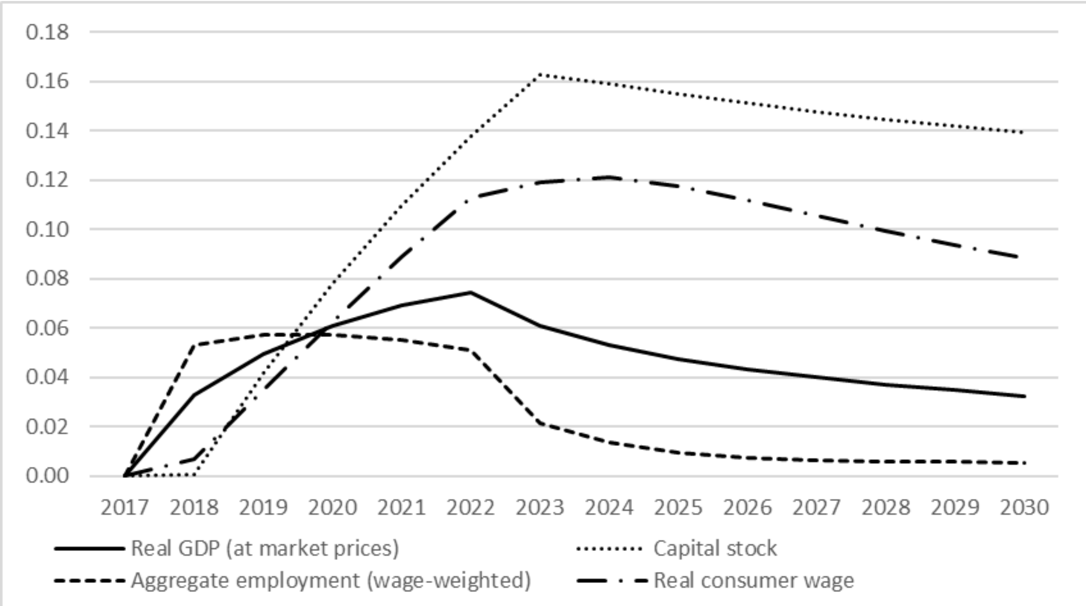

Figure 6: Top 5 sectors, ranked by 2030 output deviation (% dev'n from baseline)

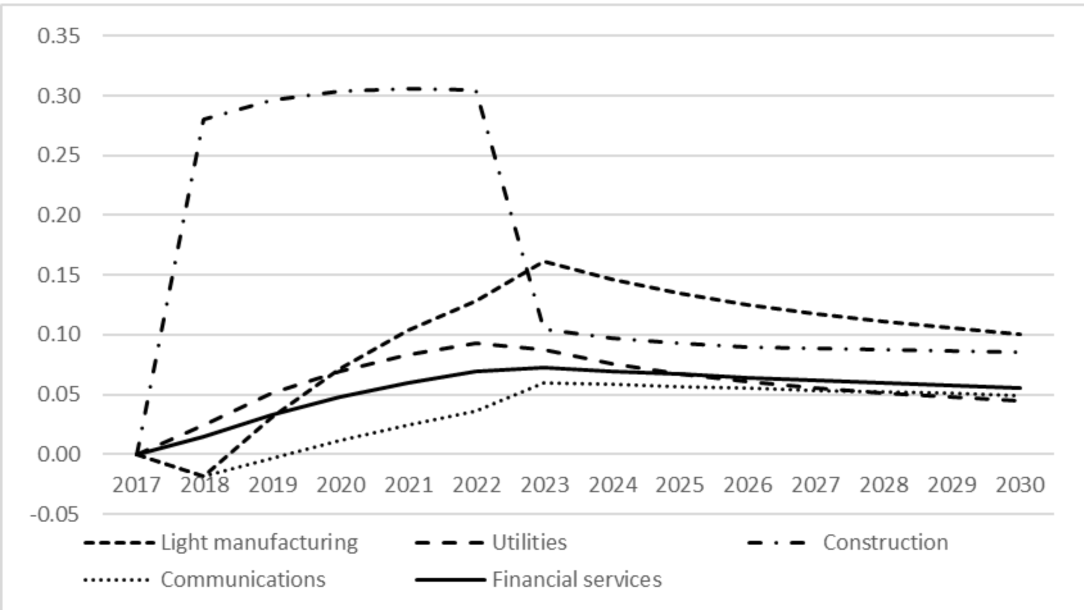

Figure 7: Bottom 5 sectors, ranked by 2030 output deviation (% dev'n from baseline)

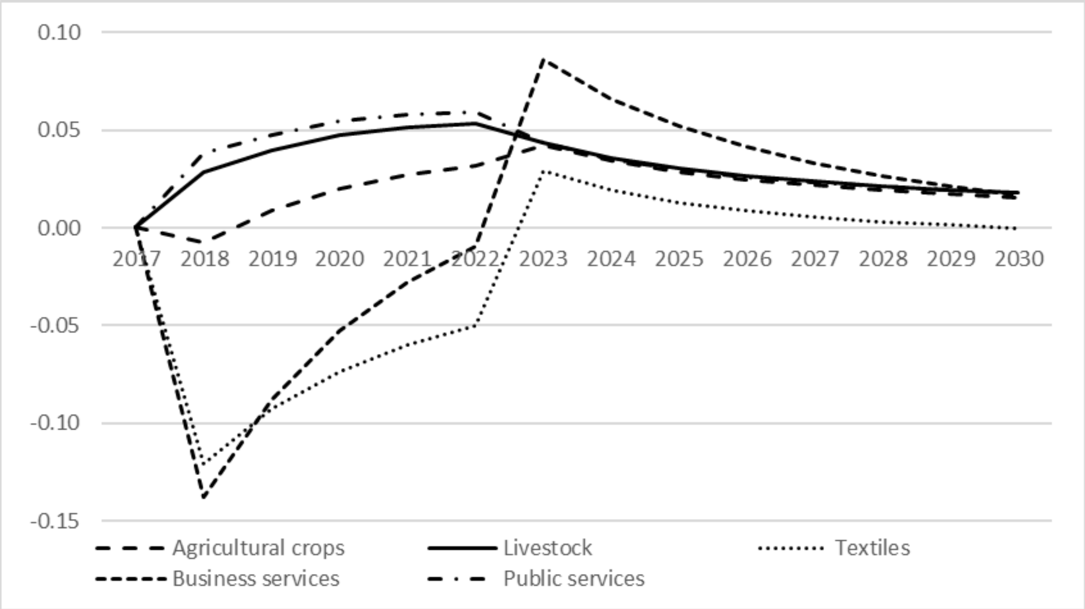

Figure 8: Middle 6 sectors, ranked by 2030 output deviation (% dev'n from baseline)

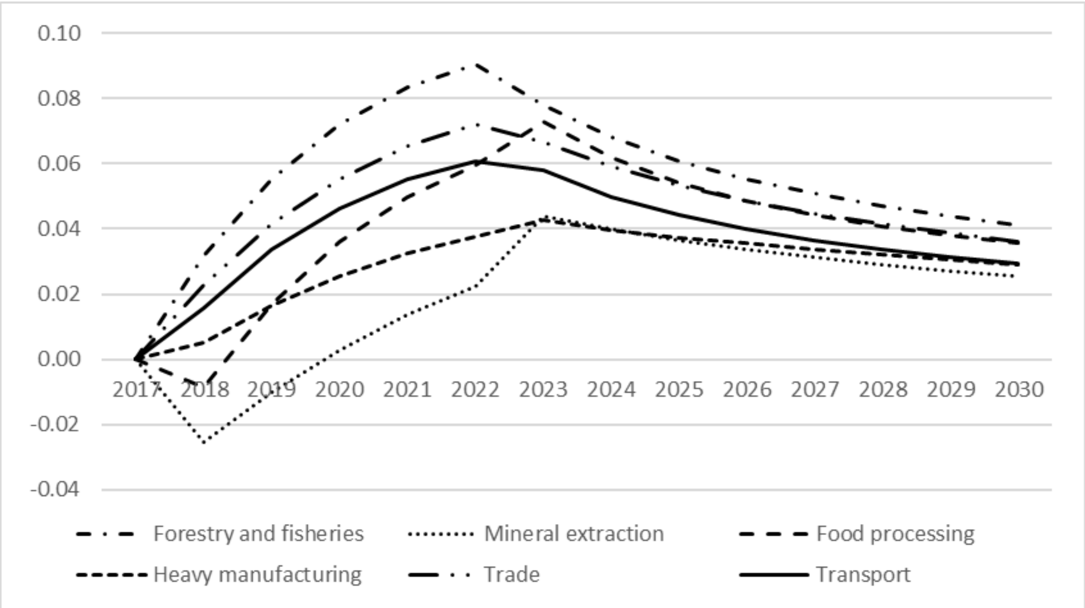

Figure 9: Employment by sex (% dev'n from baseline)

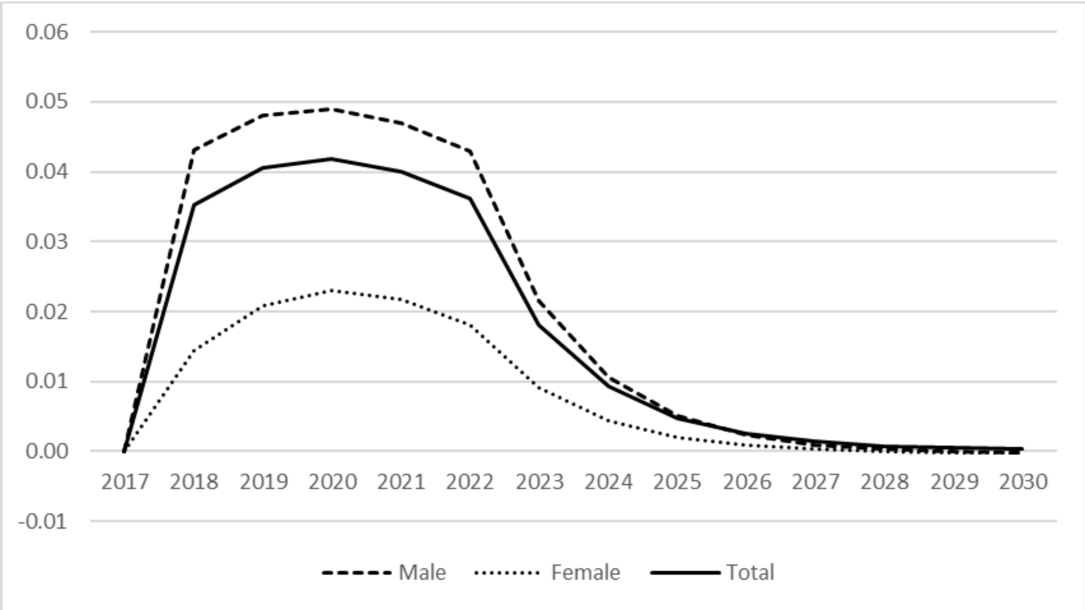

Figure 10: Factor prices (% dev'n from baseline)

Figure 11: Productivity simulation: Investment efficiency (inputs required per unit of capital formation), real investment and construction output (% dev'n from baseline)

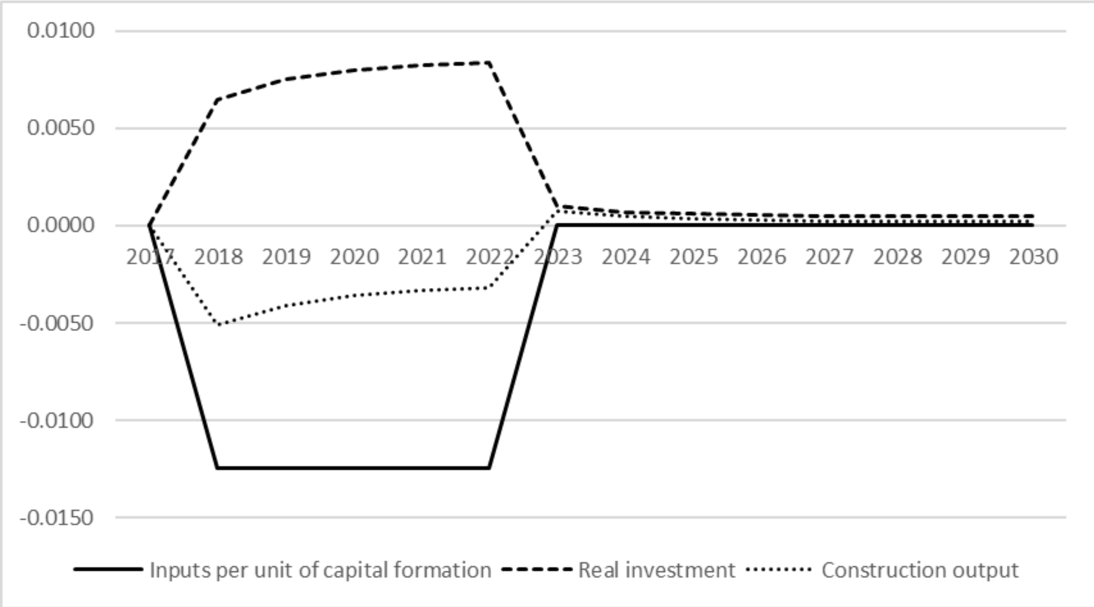

Figure 12: Productivity simulation: Employment, real wage, capital stock and real GDP (% dev'n from baseline)

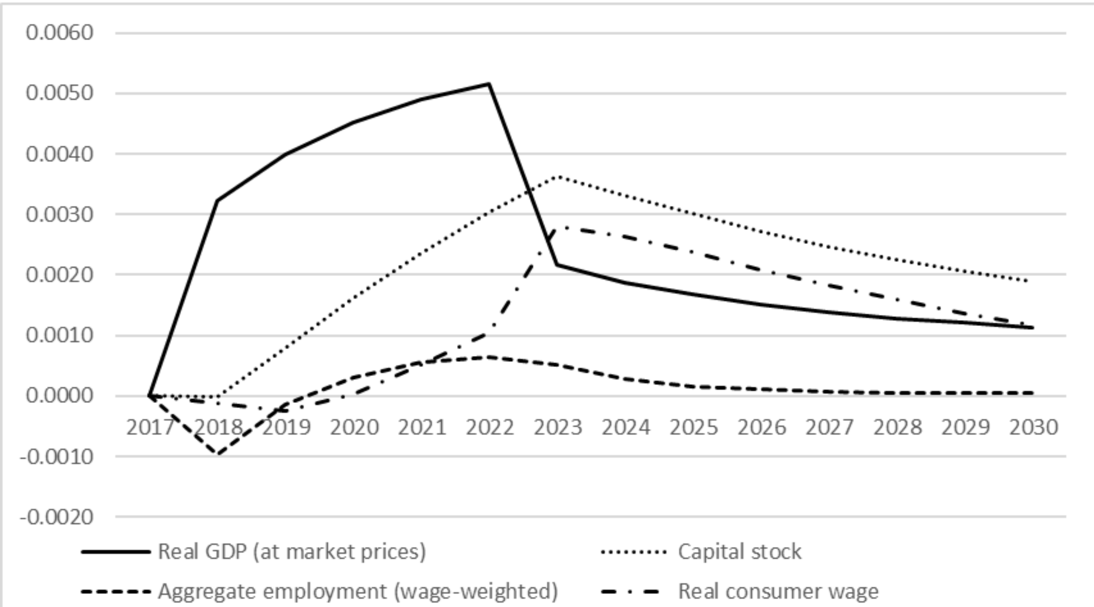

Figure 13: Productivity simulation: Price indices for consumption, investment, export prices and import prices (% deviation from baseline)

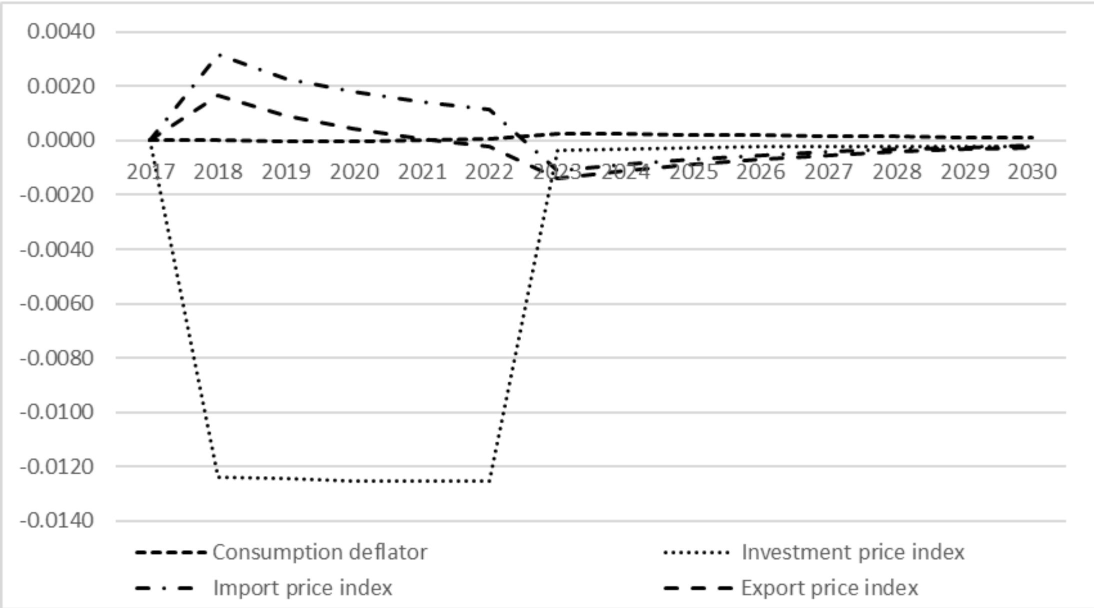

Figure 14: Productivity simulation: Real GDP, real consumption, export and import volumes, terms of trade and real exchange rate (% deviation from baseline)

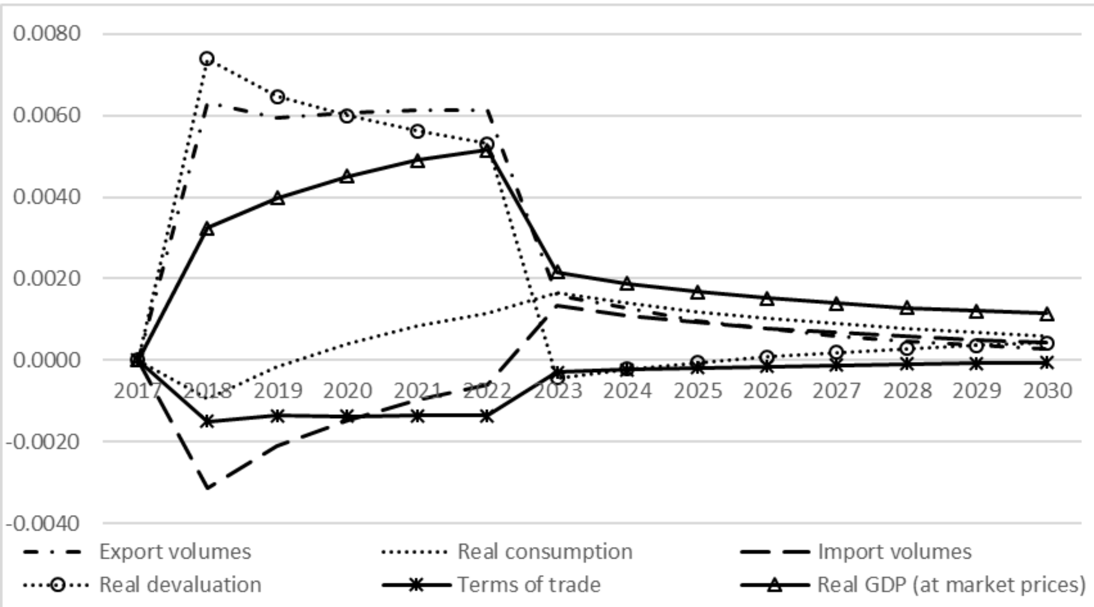

Figure 15: Productivity simulation: Top 5 sectors, ranked by 2030 output deviation (% dev'n from baseline)

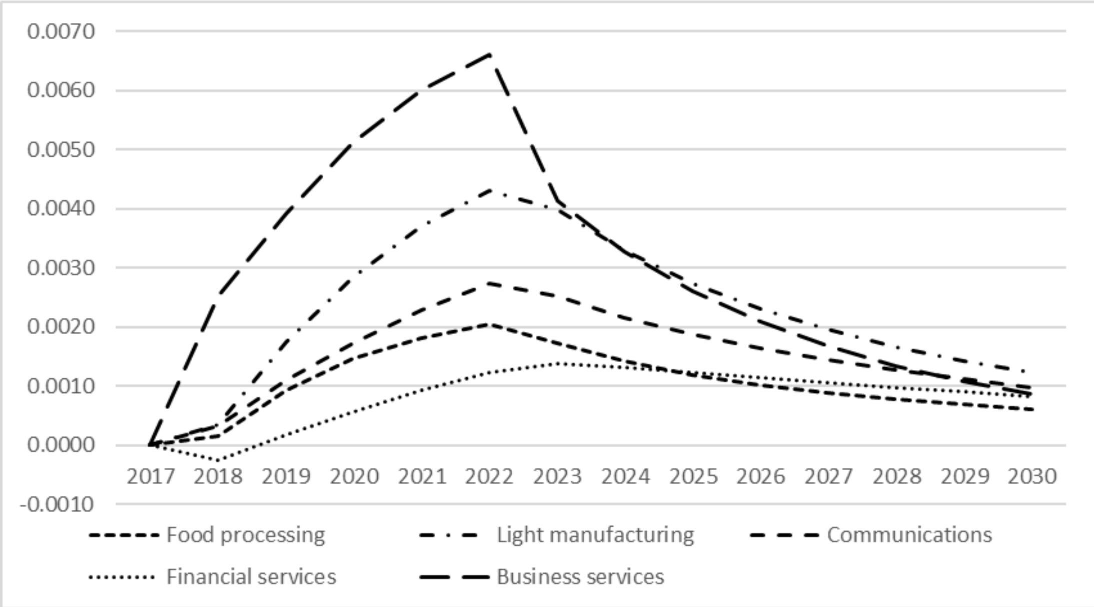

Figure 16: Productivity simulation: Bottom 5 sectors, ranked by 2030 output deviation (% dev'n from baseline)

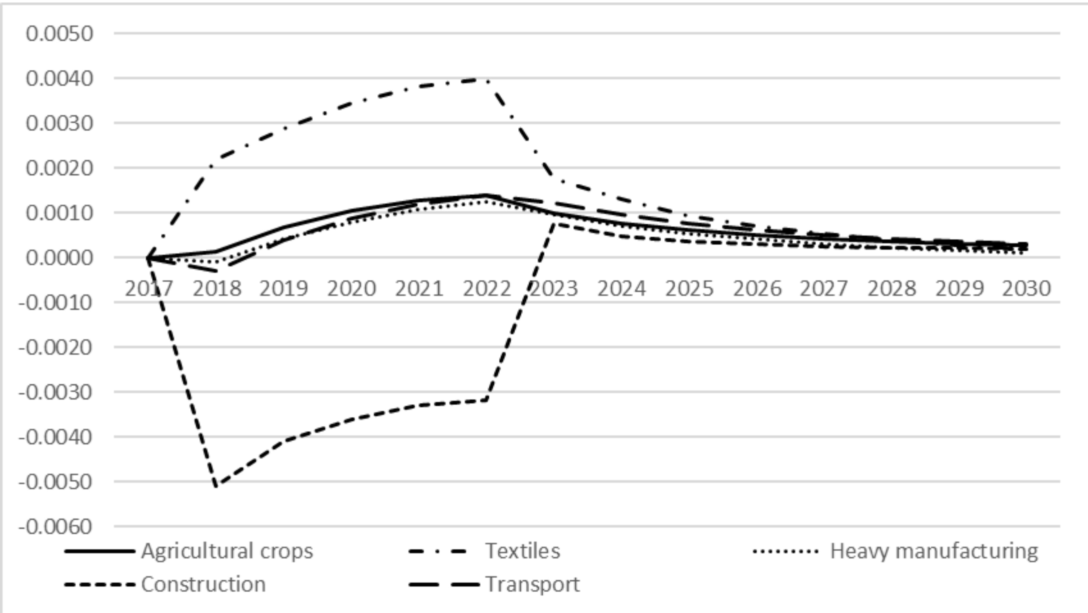

Figure 17: Productivity simulation: Middle 6 sectors, ranked by 2030 output deviation (% dev'n from baseline)

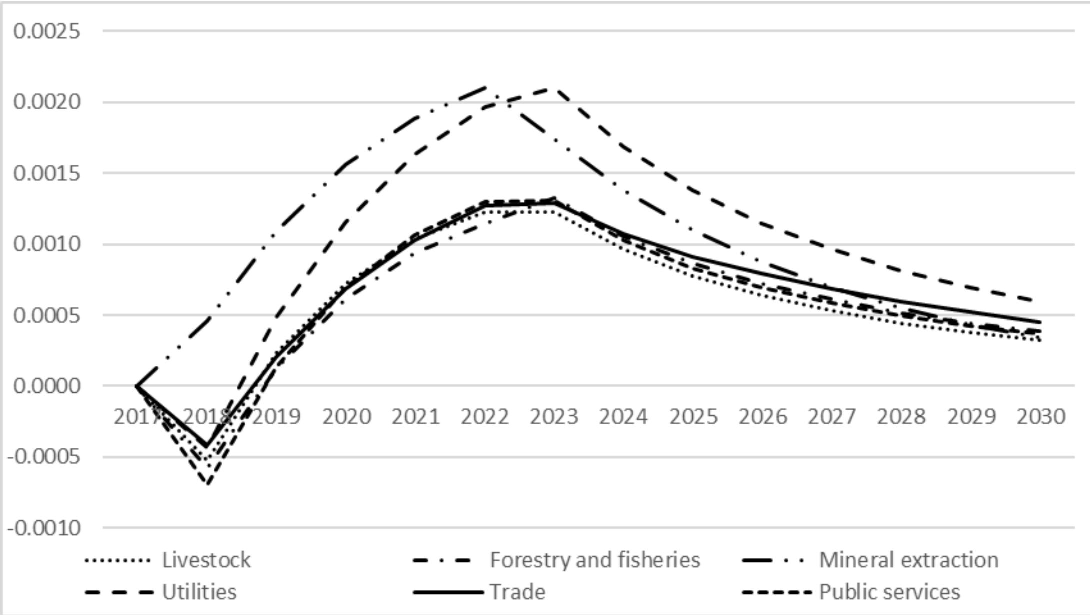

Figure 18: Productivity simulation: Employment by sex (% dev'n from baseline)

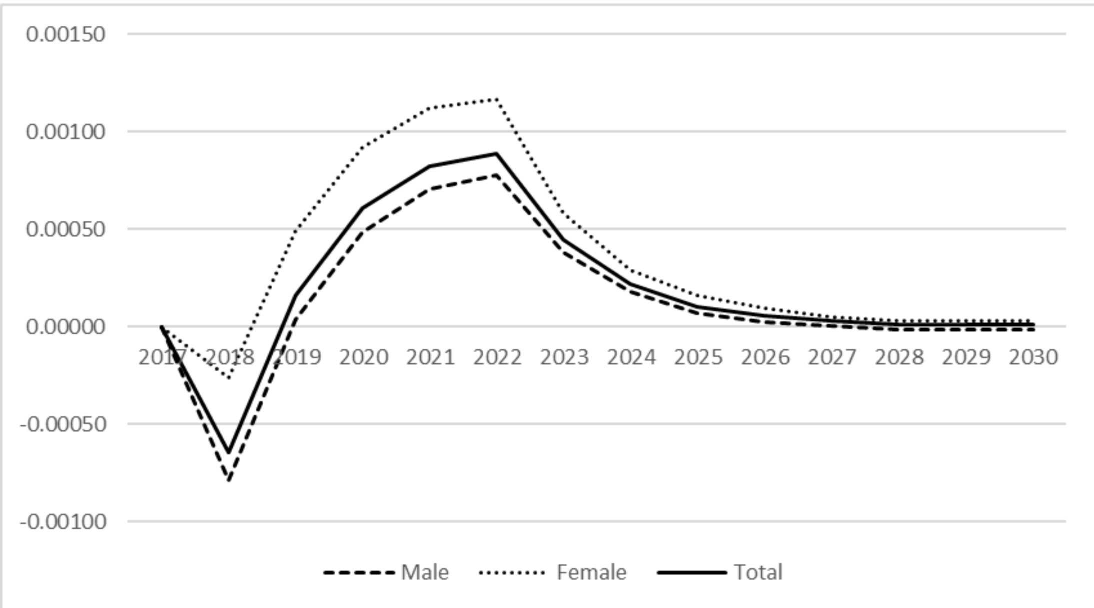

Figure 19: Productivity simulation: Factor prices (% dev'n from baseline)