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Japanese Economic Stagnation: Causes and Global Implications*

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Abstract

Despite Japan's prominence in global finance and trade through the 1980s its global role has appeared to diminish with its recent stagnation and the rise of China. This paper reviews the claimed sources of Japan's stagnation, including productivity and labour slowdowns, monetary policy in the aftermath of the Plaza Accord and the surge in China's growth. Their independent effects are quantified using a multi-region global dynamic model. The productivity slowdown emerges strongest though its exogeneity is questioned. The resulting losses are shown to have been severe for the Japanese but mild in other regions, disguised by the rise of China.

1. Introduction

The performance of Japan's economy since the 1980s presents numerous conundrums. Having led global economic growth in the 1960s and 1970s and retained strong performance into the 1980s, it appears to have stagnated since. Considering that the growth pattern in numerous other East and Southeast Asian economies mirrors that of Japan, the sources of this stagnation are important. Indeed, Japan's slowdown has coincided with the comparatively rapid expansion of mainland China and the two may well be interlinked. The genesis of Japan's slowdown appears to have been in the aftermath of the Plaza Accord Yen appreciation of the late 1980s, while one of China's major growth accelerations occurred with important reforms to the tax system and the exchange rate in 1994. It surged into a comparative vacuum left by Japan at around that time.

Numerous alternative hypotheses have been offered to explain Japan's apparent stagnation. The supply side stories centre on an apparently coincidental slowdown in productivity growth around 1990 (Saito 2000, Hayashi and Prescott 2002), comparatively poor performance by Japan's services sector (Clark 1978, Kay and Clark 2005, Fukao 2010), and a declining birth rate that has yielded an ageing and contracting labour force (Aloy and Gente 2009, *Economist* 2010). Demand side stories include Japan's response to external pressure from the mid-1980s that allowed substantial real appreciations against the US (McKinnon and Ohno 2001, Hamada and Okada 2009, Corbett and Ito 2010) and its monetary policy response that allowed deflation and a liquidity trap since the early 1990s (Krugman 1998, Bayoumi 2001, Hoshi and Kashyap 2004, Hamao et al. 2007, Koo 2009). To these we can add the high productivity growth in mainland China, which has diverted investment funds abroad. Understanding the contributions and significance of each of these hypotheses is essential to assessing implications for Japan's trading partners.

This paper first confirms that comparative stagnation has occurred in Japan and examines the extent to which the international implications of this have been masked by the strong performance of China. It then turns to the causes of the stagnation, first reviewing the stories in the literature before drawing insights from the representation of Japan in a real dynamic model of the global economy in which growth stems from demographic change and the accumulation of physical and human capital. Supply side determinants (productivity “catch-up exhaustion”, technical inefficiency in services and demographic changes) are most readily represented in this framework, yet demand side shocks are also included via changes in risk premia, financial sector productivity and saving behaviour.

In the now well established tradition that uses structural modelling to decompose growth performance,¹ the model is used to construct a hypothetical growth path that excludes the stagnation shocks. Each shock is then examined separately as a departure from this hypothetical growth path and contributions to the stagnation are then apportioned. Not surprisingly, supply side shocks, and sectoral total factor productivity (TFP) in particular, are seen to have the largest influence, though the domestic demand side stories emerge as important and not always negative in consequence. Their effect is seen to fall mainly on prices, incomes and the real exchange rate, with supply side shocks dominating changes in GDP.

For the world as a whole the loss of continued Japanese growth, through the early 2000s at least, is masked by continued strong growth elsewhere in East and Southeast Asia. Simulated real global trade is smaller than it would have been had Japan continued on its late-1980s path and most of Japan’s trading partners are shown to have lost real exports as a consequence. Although the modelling takes productivity shocks as exogenous and so does not draw direct links between the post Plaza Accord real appreciation, the boom bust cycle that followed it and the eventual stagnation, this concatenation appears otherwise to have been too coincidental (Horioka 2006). Given that the US was the principal protagonist behind pressure for the late 1980s appreciation, following it up with a legislative attack on apparent exchange rate protection, it is of interest to inquire whether the US was a beneficiary from subsequent events. The analysis presented here shows this not to have been the case. Indeed, the global economy was retarded and real incomes in the Western industrial economies are shown to have been smaller as a consequence of Japan’s stagnation.

¹ Early applications of these general methods are by Dixon and Rimmer (2002). Examples related to Asian economic performance include recent work by Robertson and Xu (2010).

The section to follow presents the evidence for stagnation in a global context while Section 3 reviews the many economic stories offered to explain it. Section 4 is a description of the model and the construction of the historical simulations. Section 5 describes the decomposition of Japan's stagnation amongst its claimed causes while Section 6 assesses the net effects on the Japanese and international economies. Section 7 offers a short summary and suggestions for further research.

2. Japan's Economic Stagnation in a Global Context

First, it is useful to confirm that the term “stagnation” applies. The pattern of Japan's nominal and real GDP growth is shown in Figure 1. While nominal growth certainly stagnated after 1990, there are several reasons why stagnation might be an inappropriate term. First, the post-bubble period has been deflationary and so real growth should look better than nominal. Second, following the bubble economy a return to a benchmark growth path might be expected, requiring a temporary interval of slow growth. Third, Japan's population has stopped growing and, because it is ageing, its workforce has been contracting. Performance per capita, or per worker, must surely have been better than that in aggregate. Fourth, despite its very successful manufacturing brands, Japan is now a service economy. Growth in such economies is poorly measured since, for many service industries at least, output is difficult to measure and is often recorded as merely the value of the inputs used. While no solution is offered here to the fourth of these provisos, the possibility that strong performance is disguised by a shrinking labour force is addressed in Figure 2, which shows that there was some growth in real GDP per worker, a little less in real GDP per capita and virtually none in real consumption per capita. The stagnation would therefore appear to be real so far as the available data go.

A weakness of the extensive literature on Japan's stagnation is that it only rarely considers it in a global context. Critically, while Japan's economy was slowing, that of its near neighbour, China, was expanding rapidly. With this “changing of the guard”, the net economic effects on trading partners were rendered less perceptible. Figure 3 shows Japan's and China's shares of global GDP, compared at market exchange rates.² The path of their

² When the shares are constructed using PPP adjustments from the Penn World Tables database, the path of China's share (version 1) shifts up two to three fold and the total grows, but the story remains the same.

total GDP holds a stable share of global GDP by this measure, with the decline in Japan's individual share being closely matched by the rise in China's.³

3. Economic Stories about Japan's Stagnation

There are numerous surveys of the literature on Japan's economic performance of recent decades, ranging from the very general (*The Economist* 2010) to the more deeply analytical (Boltho and Corbett 2000, Miyao 2006, Horioka 2006, Tyers and Corbett 2012). The stories they cover can be divided between those emphasising supply side causes (productivity and labour supply) and those emphasising demand side shocks (financial failures and monetary policy). Both literatures are large and persuasive.

3.1 Productivity "catch-up" exhaustion and service inefficiency

As the story goes, Japan's very fast expansion from the 1950s to the 1970s depended significantly on the use of technologies available from abroad. As it approached the global technical frontier, further opportunities for such growth diminished (Lincoln 1988). Subsequent productivity growth would then depend on Japan's contribution to the advancement of this common technical frontier, reducing its GDP growth potential to no more than 2% per year (Yoshikawa 2000). Supply siders and real business cycle specialists approach Japan's "lost decade" of the 1990s with emphasis on this underlying productivity slowdown, treating it as exogenous (see, for example, Hayashi and Prescott 2002, Morana 2004, Kobayashi and Inada 2005). The sharpness of Japan's growth decline can be further explained by a delay in the recognition of this diminished growth potential and therefore over-optimistic capital accumulation through the 1980s and early 1990s (Wilson 2000, Beaudry and Portier 2004, 2007). The arrival of more modest expectations then saw a loss in capital value and a decline in both investment and consumption (Ramaswamy and Rendu, 1999).

Doubt might be cast on the "catch-up exhaustion" story, however, due to its coincidence with the boom and bust of the late 1980s and the subsequent stagnation in real domestic investment. One source of such doubt is the comparatively poor performance, at least as measured, of Japan's services sector. As Figure 4 shows, even after the early 1970s and

³ While there is no space for it here, the corresponding trade and foreign investment stories are similar. Japan's share has fallen while China's has risen, while their combined shares have grown only modestly.

through 1989, manufacturing productivity was still growing at about 3.4 per cent per year. The labour force was expanding then, allowing GDP growth to average 4.5 per cent per year. Meanwhile services transitioned from slow growth to complete stagnation. By comparison with other industrialised countries, Japan's services are riven with monopolies and oligopolies sustained at least in part by policy induced high entry costs and public assistance (Imai and Kawage 2000, Fukao 2010a). Possibly as a consequence, service industries have been comparatively slow to adopt information technology innovations and have had comparatively low rates of "intangible" investment (Fukao 2010). Yet the comparatively poor performance of Japan's service industries is not new, as reference to it by Clark (1978) and Hirschmeier and Yui (1981) attests. Solutions have been slow to appear since they apparently tear at Japan's cultural fabric (Kay and Clark 2005). There is even the argument that narrowly defined inefficiencies are, or might potentially be, net welfare improving in a Japanese context (Gadir 2009).

Nonetheless, the oligopolies and entry restrictions cause a substantial cost burden while at the same time raising rents that enhance corporate saving – now the primary source of Japan's current account surplus (Bayoumi et al. 2009).⁴ The result is that growth in consumption expenditure is constrained by a comparative lack of access to capital income, due to the tradition of financing investment from retained earnings so that dividend payments are low.

3.2 Labour force contraction

Adding demographic behaviour to neoclassical growth models tends to yield the standard Solow-Swan growth model story - that slower population growth slows the growth rate of GDP but raises labour's marginal product and hence the growth rate of wages and real per capita income (Pitchford 1974, Aloy and Gente 2009). For economies that are initially young, this per capita income boost is bolstered by the "demographic dividend", due to a rising labour force relative to population. In Japan's case, however, youth dependency was already low in the 1980s and so there were none but the most temporary remaining gains from fertility decline and hence reduced youth dependency.⁵ Also wielding secondary influence are the lack of replacement immigration (which has been shown to raise labour

⁴ More recent evidence of a highly concentrated and protected corporate structure appears in the wake of the global financial crisis, during which diversity of firm performance actually fell in Japan while it rose substantially in the US. See Hamao et al. (2007).

⁵ Since the declines in Japan's labour force have not been even partially offset by increased immigration, there may also be a loss of opportunity to raise productivity by this means (Peri 2010).

productivity, Peri 2010), increased human capital investment to replace lost labour (Beaudry et al. 2005), reduced saving (Horioka 2006), reduced entrepreneurship performance, matching problems in labour markets with already trained older workers and the slowing of home markets for frontier products sought by the young, which in turn weakens incentives for productivity-enhancing private investment.

3.3 Domestic demand side stories

It is well understood that Japanese monetary policy has, during some periods at least, targeted the Yen-dollar rate while at the same time the Bank of Japan has come under substantial pressure from the US for Yen appreciation.⁶ The Plaza Accord is the most famous instance, though it was followed by the formalisation of this pressure via the US *Exchange Rates and International Economic Policy Coordination Act of 1988*. While this pressure was relaxed at least for a period in the 2000s to allow a depreciation (Taylor 2006, 2007), the appreciations that had gone before were immense, as indicated in Figure 5. Japan's underlying real exchange rate appreciated by 74 per cent after the Plaza Accord and by a further 42 per cent during the early 1990s. This reduced the competitiveness of Japan's tradable industries, which had hitherto been the primary source of its economic growth. Indeed, the appreciations are said to have led to periods of *endaka fukyo*, or strong Yen induced recessions (Hamada and Okada 2009, Obstfeld 2009).

The largest of the real appreciations occurred in response to an explicit strong Yen policy, which invited a slowdown in Japan's net financial outflows.⁷ Despite a subsequent surge in investment that might have been expected to embody technical improvements, this coincided with the productivity slowdown discussed above. The rise in home investment was financed mainly by home saving, so it cut Japan's current account surplus and hence it raised the proportion of Japan's domestic income being spent at home, increasing home relative to foreign prices.

Other things equal such a surge in investment might be considered positive for home activity and employment, even given the expectation that it would be temporary. But this must be traded off against the broader implications of the source of the impending appreciation,

⁶ See Henning (2008), especially Chapters 3-4.

⁷ This slowdown in outflows was almost entirely private since changes in the central banks' stock of foreign reserves did not fall in this period. The statement of a strong Yen policy was enough to change private expectations and induce a refocusing of investment domestically.

namely an associated monetary contraction. Certainly it must have reduced the risk premium on home investment by minimising depreciation risk, yet such an announcement to a forward looking market might also have foreshadowed an eventual deflation and therefore unemployment and a loss of income. This suggests, at minimum, that the temporary nature of the investment surge was not anticipated.

Ironically, the announcement of the intended appreciation was sufficient to trigger the investment boom without any monetary contraction. Home relative to foreign demand rose, causing a substantial underlying real appreciation. Indeed, the appreciation commitment notwithstanding, the Bank of Japan appears to have lent against the boom, presumably to keep to the agreed realignment. This is said to have created the bubble economy, which was then addressed too late by contractionary policy in the early 1990s that only exacerbated the subsequent bust and tended to further appreciate the Yen. In turn, the later 1990s saw a switch to expansionary policy, though this also came too late and was constrained by a liquidity trap. Financial elements of this broad sequence include post-bubble asset price deflation, inadequate returns on saving, debt overhang and the disruption of financial intermediation due to non-performing loans (Posen 1998, Bayoumi 2001).⁸ As Figure 6 shows, investment declined even as a proportion of GDP throughout the stagnation period. Monetary expansion was seen, nonetheless, as the best exit strategy (Krugman 1998, Ball 2008), yet this proved difficult due to political sensitivity to Yen depreciation, the US reaction discussed above and the very low interest rates maintained at the time by the US Federal reserve.

A closely related story is that of the “balance sheet” recession (Koo 2003, 2009), where solvent but heavily indebted firms use new income to de-leverage rather than finance further investment. This is of potential importance in Japan where, as household saving fell with ageing, the high average saving rate was driven increasingly by corporate retained earnings (IMF 2006, Bayoumi et al. 2009). Deleveraging is then one potential contributing explanation for the decline in the gross domestic saving rate shown in Figure 6, which brings us to the intersection between Japanese private saving and its industrial structure.

Heavy manufacturing and services in Japan are oligopolistic with close relationships between the largest groups of firms and the government. Corporate income therefore includes substantial oligopoly rents and, since dividend payments to owners are low, more than a fifth

⁸ Investment demand had collapsed in part due changes in expectations and the liquidity trap ensured that the resulting deflation could be checked only by resort to “quantitative easing” (Eggertson and Ostry 2005).

of its GDP takes the form of corporate savings (Bayoumi et al. 2009). This oligopolistic structure appears to be protected by comparatively high entry and exit costs, with rates of business start-up in Japan low by OECD standards and declining (Imai and Kawagoe, 2000). It is in this context that the Koo (2009) balance sheet recession thesis makes sense, otherwise low financing costs would encourage substantial green-field investment.

3.4 Very high productivity growth in a large near-neighbour accepting FDI

In economic models with two trading regions it is readily seen that accelerating productivity in one region stagnates GDP in the other as savings are directed to investment abroad. Income growth (GNP rather than GDP) continues in the stagnating region, albeit more slowly than in the dynamic one. More generally, and in the case of China in relation to Japan, Chinese inward FDI tends to be associated with outsourcing of labour-intensive industrial components or product assembly, one consequence of which can be improvement in the measured productivity of the originating industry.⁹ The scale of the net effect on Japan's economy depends on the portion of its current account surplus that goes, directly or indirectly, to China (Fujiwara et al. 2008). While Ahn and Lee (2007) find supporting evidence for the case of Korea, where FDI flows to China tend to decrease local growth, this does not appear to have been addressed in the case of Japan.

4. Modelling Japan's Stagnation and its Effects

The model used is dynamic and global in scope and it has a common production and consumption structure with Hertel et al. (1997) and Ianchovichina and Walmsley (2012), though it differs in other respects, including the incorporation of demographic behaviour, following Tyers and Shi (2007). The key technical innovation in this paper is in the model's use to construct "historical simulations" for decomposition and counterfactual analysis, following Dixon and Rimmer (2002, 2004, 2010). Consider first the elements of the model's structure most relevant to this exercise.

4.1 Model structure

⁹ Robertson and Xu (2010), for example, use a retrospective dynamic model to examine the zero-China-growth counterfactual, finding that other Asian economies benefited from Chinese growth due to its lowering of durable goods import costs.

Broadly, the model is defined on 18 regions and it is recursively dynamic.¹⁰ Industries are aggregated into seven sectors as indicated in Table 1, with services little traded in comparison with the others. Consumers, firms and governments substitute imperfectly between products from different regions, as represented by nested CES structures over products and services and their home and imported varieties. Output in region r and sector j takes the form:

$$(1) \quad q_{rj} = A_r^R A_{rj}^Q \left[\beta_{rj}^V V_{rj}^{-\rho_V} + \beta_{rj}^Q Q_{rj}^{-\rho_V} \right]^{-\frac{1}{\rho_V}},$$

where V is a composite of primary factors and Q is a composite of intermediate inputs. A^R is a region-specific but product generic productivity factor that enhances output in all sectors, A^Q is a region and product specific productivity factor and ρ_V is the CES parameter that embodies the elasticity of substitution between value added and expendable inputs. V and Q are then similar functions of primary factors and intermediate inputs, respectively. That for V is:

$$(2) \quad V_{rj} = A_{rj}^V \left[\sum_k \gamma_{rjk} f_{rjk}^{-\rho_j^F} \right]^{-\frac{1}{\rho_j^F}},$$

where the primary factors are indexed as k and include land, production labour, skilled or professional labour, physical capital and natural resources. A^V is a total factor productivity coefficient. Technical change is exogenous in the model, introduced in the form shocks to A^V based on estimates of total factor productivity performance by industry.¹¹

Regional capital accounts are open so that regional households hold portfolios of assets that are claims over home and foreign capital. Investors in region r have adaptive expectations about real net rates of return on installed capital, r_r^c , the determinants of which might be simply summarised as:

$$(3) \quad r_r^c = \frac{P_r^Y MP_r^K}{P_r^K} - \delta_r,$$

¹⁰ The regions are Australia, North America (Canada, US, Mexico), Western Europe, Central Europe and the former Soviet Union, Japan, China, Indonesia, Other East and Southeast Asia, India, Other South Asia, Latin America, Sub-Saharan Africa, North Africa and the Middle East and the rest of the world.

¹¹ The EU KLEMS database is a key source of total factor productivity estimates. See <http://www.euklems.net/>, March 2008.

where P_r^Y is the region's GDP price, MP_r^K is the marginal product of physical capital, P_r^K is the price of capital goods (a separate industry defined in the model), and δ_r is the depreciation rate. Given this rate of return the determination of investment in each region can be simply characterised as follows. Reminiscent of Tobin's Q, it is driven positively by the real net rate of return, r_r^c , and negatively by the rate that must be returned to savers, or the real financing cost, r_r . Thus, the real volume of capital goods demanded is

$$(4) \quad I_r = I(r_r^c, r_r).$$

To arrive at r_r , a global interest rate, r^w , is first defined such that $r_r = r^w + \pi_r$, where π_r is a usually exogenous regional interest premium, which captures the effects of capital controls in the one hand (market segmentation) and differential regional risk on the other. The global rate, r^w , and indirectly r_r , is then derived to clear the global market for financial capital:

$$(5) \quad \sum_r \left[\sum_g S_{gr} \left(\frac{Y_{gr}}{N_{gr} P_r^C}, A_r^S, r_r \right) \right] = \sum_r P_r^K I_r(r_r^c, r_r),$$

where the S_{gr} is the total saving of each age-gender-skill group, g , in region r , the quotient is real group income per capita and P_r^K is the regional price of capital goods. The coefficient A^S is a group-generic shifter of savings behaviour which is used later to examine the link between aggregate performance and the saving rate.¹²

Lagged adjustment processes embedded in the $I(r_r^c, r_r)$ ensure that financial capital is not sufficiently mobile internationally to equate r_r^c and r_r in the short term, but that their paths converge in the long term unless exogenous shocks prevent it. Baseline values of the interest premia, π_r , are calibrated to yield observed trends in shares of global investment.¹³

Investment then places demands on a capital goods sector in each region which merely applies CES technology to the combination of products supplied in the economy, without

¹² Government is represented in the model and has expenditures that differ in structure from private final demand, but it does not save or borrow, rather its expenditure varies with endogenous revenue from direct and indirect taxes. The rise in fiscal deficits later in the period of analysis is represented as reducing private net saving via calibrated shifts in A^S .

¹³ The investment shares are simply extrapolated for the years beyond 2010. The risk premium for China diminishes through time in a manner considered to be due to financial reforms (Tyers and Golley 2010).

value added. Thus, the real volume of capital goods supplied places derived demands in home product and service markets. Thus, for each region the real volume of investment is:

$$(6) \quad I_r = A_r^K \left[\sum_j \alpha_{rj} y_{rjK}^{-\rho_{rK}} \right]^{\frac{1}{\rho_{rK}}},$$

where y_{rjK} is the regional volume of good or service j that is used in constructing capital goods. In practice, investment is intensive in heavy manufactures and (financial and construction) services. Importantly, the coefficient A_K indicates the productivity of the financial market. The delivery of real capital goods is more costly the lower is A_K . From (6), product demands are derived for the capital goods sector by choosing the mix of inputs to minimise cost. The price of capital goods, P_K , then emerges as a CES index of the prices of the components.

As in other dynamic models of the global economy, the primary endogenous component of simulated economic growth is physical capital accumulation. Though it is of less import in the case of Japan, growth also stems from the transformation of production workers into skilled or professional workers. The characterisation of changes in labour supply and quality is via the incorporation of complete demographic behaviour.¹⁴ Populations in four age groups, two genders and the two broad occupational categories are tracked through time: a total of 16 population groups that constitute separate households in each defined region.¹⁵ Each age–gender–skill group is represented as a homogeneous sub-population with a group-specific birth and death rate, labour force participation rate and rates of immigration and emigration. Each group also has independent consumption-saving behaviour, which, as indicated in (5), is endogenous to current real per capita income and the real home interest rate but not forward looking.

4.2 Constructing Baseline and Counterfactual Simulations

¹⁴ The demography embodied in the model has been detailed in such published work as Tyers and Shi (2007), Tyers and Golley (2010) and Golley and Tyers (2011, 2012). Since demographic analysis plays a minor role in this paper, the interested reader is referred to that literature for further details.

¹⁵ The subdivision between production workers and professionals and para-professionals accords with the International Labour Organisation's occupation-based classification and is consistent with the labour division adopted in the GTAP Database. See Liu et al. (1998). Households transition from production to professional at via estimated training behaviour the rates of which depend on the real wage premium, the share of production workers in the labour force and the level of real GDP per capita.

Before a counterfactual analysis can be carried out it is necessary to construct a baseline simulation that exhibits key elements of the observed behaviour of the Japanese economy in the two decades following 1985. This baseline can then be compared with counterfactual simulations that exclude some or all of the stagnating shocks. Two counterfactuals, or “comparators”, are constructed: one that excludes all stagnating shocks and the other that excludes all shocks of Japanese origin, thus including productivity growth in China (considered stagnating for Japan since it appears to have sapped Japanese investment). The purpose of the first is to decompose the stagnation and that of the second is to examine what Japanese performance might have been like in the absence of home grown shocks.

The baseline

Since the model is recursive, with solutions for each year depending only on data for previous years, the required database is a complete solution for single initial year. Consistent multi-product global databases are demanding to construct and none is available for 1985. A synthetic database is therefore constructed using a set of backward comparative static shocks originating with the 1997 GTAP 5 global database.¹⁶ The synthetic database is complemented by adding demographic data for that year to provide a base for recursive forward dynamics that includes demographic behaviour. With population dynamics thus covered, what is still required for forward simulation from 1985 is a sequence of shocks to the regional investment risk premia, π , the saving shifter A^S and the various productivity coefficients A^V , A^K , A^R , A^Q and A^K . Exogenous estimates of total factor productivity shifts, A^V in (2), are first supplied for all regions and sectors.¹⁷ Then, a calibration step is required to capture the short term fluctuations in performance of the Japanese and global economies in the two target decades and in representing the seeds of Japan’s eventual stagnation. So a “pre-base” forward simulation from 1985 is first made in which the normally exogenous parameters that are difficult to observe are rendered endogenous, swapped for normally

¹⁶ This is done comparative statically (in a single step), using a version of *RunGTAP* on the GTAP 5 Database, shocking capital stocks backward along with populations and TFP with regional GDP targets being met via endogenous residual comparative static changes to A^R . The backward sector specific productivity shocks are derived primarily from accumulating annual changes in the EU KLEMS database (Figure 4). For China, productivity estimates from Tyers et al (2008) are used and for other non-OECD regions, only the A^R shocks are used to achieve target 1985 real GDP levels.

¹⁷ As in the back-casting, for the forward simulations we use the EU KLEMS database (www.euklems.net) with annual results smoothed via a five year centred moving average. In the key case of China, sectoral productivity results are from Tyers et al. (2008). For other non-OECD regions no A^V shocks are used; instead real GDP is made exogenous and A^R shocks calibrated, as indicated in Table 3.

endogenous variables that are readily observable over the period.¹⁸ The swaps are listed in Table 2.

The idea here is that the demand side issues discussed in Section 3 can be broadly represented in a real dynamic model with open capital accounts via a combination of changes in the parameters π , A^S , A^V , A^Q , A^R and A^K . The first group of calibration swaps, to all regions' investment risk premia, π , are required to incorporate the effects of region-specific riskiness or capital controls that segment financial markets. The second, for the private saving rate, is to capture shifts in saving behaviour (shocks to A^S), that are due to expectations formation not represented in the model.¹⁹ The remaining swaps serve two purposes. First, they introduce short run changes in regional and sectoral productivity, via shocks to A^R and A^Q (services) that modify the smooth paths of the A^V coefficients for each sector in Japan and China. Second, changes in financial or investment efficiency are built in as shocks to Japanese and US values of A^K . The latter is in the tradition of Hubbard (1998) and recent empirical extensions by Reinhart and Rogoff (2004), and Caselli and Feyrer (2007). In combination with the calibration of A^Q (services), this helps to capture shifts in the cost and composition of investment, for example the boom shift toward property and away from equipment.²⁰

The dynamics of the collective of demand side shocks is thus calibrated.²¹ This also serves to cover the key determinants of Japan's real exchange rate, which follows the extraordinary path of Figure 5.²² These are:

1. *Short run changes in real financial capital flows*: surges of financial inflows raise aggregate demand at home relative to that abroad and therefore raise the home price level relative to that abroad,

¹⁸ Again, this follows the approach of Dixon and Rimmer (2002: 38-42, 240-261; 2010).

¹⁹ The incorporation of fully forward looking expectations would not remove this requirement since important expectational errors were made by Japanese agents in the late 1980s and early 1990s.

²⁰ Further extensions on related themes are by Portes and Rey (2005), Corsetti et al. (2007) and McGrattan and Prescott (2008). A prior application using a similar model is by Tyers and Bain (2008).

²¹ As suggested by one reviewer, the exercise in calibrating the five Japanese target variables (Table 2) with five initially endogenous shifters turned out, in fact, to be less straight-forward than indicated here. When all five closure swaps were imposed simultaneously the Gempack software failed to find a solution. So, instead, four of the Japanese closure swaps were imposed with the financial productivity coefficient retained exogenous for both Japan and the US but adjusted by trial and error until the path of the real exchange rate was approximated to within a tenth of the path shown in Figure 5.

²² The real exchange rate for one region is the rate at which a representative bundle of its outputs can be exchanged with a corresponding bundle of outputs from a foreign region. In the model all prices in all regions are defined relative to a single numeraire. So the real exchange rate of any region, relative to the US, is simply the ratio of that region's GDP price with that of the US.

2. *The comparative productivity of the mostly non-traded services sector*: counterpart to the Balassa-Samuelson hypothesis, relatively low services productivity growth at home appreciates the real exchange rate by raising relative home costs, and
3. *The efficiency of the home financial sector*: for a given level of investment, if there is an (unanticipated) rise in the resources required to deliver a unit of real physical capital then that investment will raise home aggregate demand and the home price level by more and hence appreciate the real exchange rate.

The resulting baseline path of Japan's investment risk premium, π , declines into negativity at first and then recovers partially by the mid-1990s. This path might be thought of as representing the initial effects of the Bank of Japan's foreshadowing a Yen appreciation after the Plaza Accord, as discussed in Section 3. The result is a reduction in perceived downside home investment risk, or a rise in exchange rate risk associated with Japanese investment abroad. An investment boom therefore occurs, the end of which is signalled by a calibrated return of the risk premium toward its pre-boom level and a consequent collapse in real investment. Correspondingly, the path of Japan's investment efficiency, A^K , declines in the late 1980s and only begins to rise again after the mid-1990s. This is presumed to reflect a shift in the composition of investment during the boom and associated rises in financing and construction costs.

Once the pre-base simulation is constructed, the endogenous paths of the parameters π , A^S , A^R , A^Q (services), and A^K are recorded and the closure swaps reversed. The changes to these variables then become exogenous shocks in a test repeat of the baseline simulation, entitled the "base rerun" in which the same inter-temporal solution is obtained with the conventional closure.²³ This completes the calibration of the baseline and prepares the model for experimentation.

The counterfactual, or "comparator" simulations

Two of these are required. The first is for the decomposition and so it excludes the post 1985 shocks associated with Japan's stagnation and China's acceleration. The second is to assess the international implications of Japan-specific shocks and so it excludes these but includes full Chinese productivity growth. The first comparator is constructed so that:

²³ Although the baseline extends to 2009, the focus is on the period through 2007. This is because the calibration of shocks to economies other than Japan, China and the US omits the demand side shifters in this analysis and so is very likely insufficient to adequately represent global behaviour during and after the GFC.

1. Japanese and Chinese sectoral total factor productivity growth rates, to A^V , remain at their average levels in 1985-89,
2. Shocks to A^R and A^Q (services) that are embedded in the baseline for Japan are excluded,
3. Japan's birth rate is raised to replacement level, so that Japan's population and labour force continue to grow through 2010,
4. Japan's consumption (saving) parameter, A^S , is held constant as is its investment risk premium, π , and its level of investment efficiency, A^K , at their initial (1985) levels, and
5. Chinese manufacturing total factor productivity growth (in China's A^V), is set to retain its early 1980s rates throughout and so the surge of the later period is eliminated.

The second comparator includes all but item five in the above list.

The broad consequences of the exclusion of all the stagnation shocks can be seen from Figure 7, which compares the first comparator with actual performance. Not surprisingly, Japan's economy would have grown more quickly and China's more slowly throughout the period. Indeed, since 1990 Japan's average GDP growth rate would have risen from 0.8 to 5.2 per cent per year while China's would have fallen from 10.5 to 7.1 per cent per year. Despite its slower productivity growth in the comparator, China's growth is still quite strong, at least partially because of the terms of trade advantage conferred by the continued strong growth of its near neighbour, Japan.

5. Causes: Decomposing Japanese Stagnation

The contributions of supply side and demand side stories are assessed by taking the first of the comparator simulations, which is devoid of all shocks contributing to Japan's stagnation, and adding into it one set of stagnation shocks at a time. Each successive simulation accumulates the stagnation shocks until the original baseline is reproduced.

5.1 The productivity slow-down

Here the comparator is modified so that the smoothed TFP (A^V) growth paths for Japanese manufacturing and services slow from 1985 to match the trends shown in Figure 4. The result is a similarly smooth slowdown in Japan's real GDP growth so that the rate achieved

after 1990 is 1.8 per cent per year. It is worth emphasising here that the other calibrated shocks to regional (A^R), services (A^Q) and financial (A^K) productivity that are also embodied in the baseline are not added into the new simulation. The comparison of the two then reveals only the effect of the change in the smoothed path of TFP and not that of all the productivity shocks. Nonetheless, the TFP slowdown proves to be the dominant source of the stagnation, as indicated in Table 3. This is clearly supportive of the supply side arguments discussed in Section 3, though it might be expected given the exogeneity of technical change in the model. A case is suggested for linking investment to technology in further research.

5.2 Population slowdown

The second step in the decomposition is to add Japan's fertility decline after 1985 into the now adjusted comparator simulation. As indicated in Table 3, this has both positive and negative effects that here partially offset one another. First, there is a labour force decline that has the conventional Solow-Swan effect discussed in Section 3 –it reduces real GDP growth but raises growth in real income per capita. Second, the age distribution changes so that, initially, there is a decline in youth dependency – a “demographic dividend” – which further bolsters growth in real income per capita. Third, there is a rise in the average saving rate as the labour force is redistributed toward the high saving age groups (Bryant and McKibbin 2004). And finally, there is a shift in the product consumption mix toward services that changes the patterns of production, trade and investment, though these effects are very small at the level of aggregation used (Table 1). The Solow-Swan effect is dominant here, as elsewhere (Golley and Tyers 2012).

5.3 Chinese competition for investment

Similarly, the diversion of Japanese investment into rapidly expanding China also emerges as a comparatively small contributor to Japan's GDP slowdown. While domestic investment did stagnate as Figure 6 shows, the two offsetting effects discussed in Section 3 are modelled at least in part. First, there is foreign factor income stemming from the investment abroad and, second, outsourcing cheapens home labour after the mid-1990s, partially offsetting the decline in Japanese investment. On net, then, the effect of investment diversion to China emerges as only five per cent of the gap between comparator and baseline GDP by 2007.

And the rise in foreign factor income renders its effect on real per capita income still smaller as indicated in Table 3.

5.4 Demand side effects:

The collective of shocks representing demand side influences has effects that can be measured as the residual, once the contributions of TFP, demographic change and Chinese productivity have been accounted for. This residual embodies shocks to the investment risk premium, the saving parameters, investment efficiency and the short term productivity changes in the services sector, all associated with the boom of the late 1980s and the subsequent bust. As modelled, this collective has small effects on output *volume*. Yet these effects appear to have been net positive, lifting real simulated 2007 GDP cumulatively by almost a tenth (Table 3), due to investment delivered by the boom that would not have been committed under the comparator scenario. Notwithstanding the apparent high cost and sectoral inefficiency of the investment choices made, the volume of investment rose by 50 per cent between 1985 and 1990 then stagnated thereafter.

Yet the collective effects of the demand shocks were concentrated on prices and incomes. They stand out as positive through the late 1990s but sink into negativity as the stagnation continues beyond that, ultimately causing a substantial decline in Japan's 2007 real per capita income (Table 3). As a measure of Japan's labour market performance, simulated growth in the real production wage due to the demand shocks alone is stronger through the mid-1990s than it would have been under the comparator scenario, raising the level by 60 per cent over 1985, but thereafter there is deterioration. In this real Walrasian model, again considering demand side forces alone, this simulates as a sinking of Japan's real production wage after the mid-1990s to near its 1985 level. Overall, the real wage changes in this period were smaller than this but the reality was a combination of real wage stagnation and increased unemployment.

Finally, the decomposition sheds some light on the second real appreciation in the 1990s (Figure 5). Tighter monetary policy is the standard explanation, though it is not clear why this did not bring on deflation in a slowing economy. The reason suggested by these simulations was higher home costs due to a fall in financial services productivity and investment efficiency and an associated rise in labour demand and higher real wage costs. Even though real capital formation stagnated after 1990, service inefficiencies and

composition mismatches saw the real resource cost of delivering this investment continue to rise.

6. Consequences at Home and Abroad

To examine the domestic and external implications of Japan's stagnation it is appropriate to consider only Japanese shocks. The question becomes, how different would the Japanese and international economies have been had Japan not suffered the boom-bust cycle, and the slowdowns in both labour supply and productivity? For this purpose the second comparator simulation is used, wherein China's productivity follows its observed path.

6.1 The effects of Japanese shocks on Japanese performance

The second comparator simulation is compared with Japan's actual performance (the equivalent of the baseline) in Figure 8. The contrasts are striking, commencing with Japan's real exchange rate. Most notably, the real exchange rate path is extraordinarily different in the first decade after 1985 yet the eventual level arrived at by 2007 is similar. The initial real appreciation occurred by policy choice and, considering the similarity of its eventual level, the results suggest that the initial policy change was needless and deleterious, thus supporting the McKinnon thesis (McKinnon and Ohno 2001, Hamada and Okada 2009). Of course, the boom improved Japan's short term performance, as suggested by the investment and real per capita income paths, but left stagnation in its wake.²⁴

Yet the story depends on the link between the collapse of investment after 1990 and the simultaneous slowdown in the trend of total factor productivity (Horioka 2006). This link is not modelled here but the results make the story of Section 3 appealing. In it the boom was triggered by an initial commitment to sufficient monetary tightening to achieve a higher Yen following the Plaza Accord. The forward looking investors of the time focused on the commitment to appreciation, and hence the higher associated home returns, rather than the eventual contractionary consequences of a monetary tightening. Investment incentives, thus changed, resulted in the boom and the real appreciation began. So the committed degree of monetary tightening proved unnecessary. Indeed, as the real appreciation continued, the concern of Corbett and Ito (2010) is that monetary policy appears to have leaned against it

²⁴ The comparator simulation is a hypothetical basis for comparison, retaining high productivity growth and ignoring even the "technology catch-up" theory, and so it is optimistic in the second decade.

(with subsequent easing), further inflaming the initial boom. By the early 1990s investor confidence in the home economy had collapsed and both investment and productivity stagnated thereafter.

Yet there is a role for some independence of the productivity slowdown. The transformation of Japan into a service economy was well advanced and productivity enhancing investments in highly protected and politically sensitive service industries are more difficult to achieve. Indeed, Japan's services sector performance left room for further productivity growth to such an extent that services productivity would of necessity drive its future growth (Fukao 2010, Tyers and Zhang 2011).

6.2 Foreign implications of Japanese shocks

It would be surprising if Japan's stagnation did not impact the global economy in at least some way not masked by the rise of China. Indeed, considering that pressure from the US on the formation of Japan's monetary policy appears to have contributed to its real appreciations, it is of interest to examine whether the US economy gained from the consequences.

Consider first the implications for international trade. Under the simulated dynamics, Japan's substantial real appreciations through the mid-1990s curtailed its exports, though there was a subsequent recovery as its real exchange rate depreciated thereafter. Baseline Japanese export competition is therefore lessened in the early part of the period, relative to the second comparator, and it is strengthened later. Correspondingly, other regions enjoy export gains in the early part and losses later. The transition to trading partner losses occurs in the mid-1990s and is particularly sharp for other Asian economies.²⁵ By the end of the period all of Japan's key trading partners lose real exports, as indicated in Table 4, though net losses are largest in Australia and the other East Asian economies. In developing East Asia, it is possible that Japan's stagnation "made room" for substantial expansions in exports during the 1990s.

The corresponding effects on real incomes are driven by related cyclicity. The main reason for the early real appreciations is a slowdown in net financial outflow associated with Japan's investment boom. The international effects of this, as modelled, show losses in investment outside Japan and hence losses in real incomes during Japan's boom period. These real

²⁵ The sharp real depreciation was an important contributor initiating the subsequent Asian financial crisis (Garnaut and McLeod 1999).

income losses are later sustained by adverse shifts in the foreign terms of trade as Japanese goods become more expensive abroad. The subsequent real depreciating trend then causes the terms of trade facing other regions to recover and, by 2007, the net effects on Japan's near trading partners (Australia and developing Asia) are positive while those on the US and the EU remain only mildly negative. This cyclical pattern is evident from Figure 9. For Australia and the Western industrial regions the net effects on real GDP levels and real per capita incomes are uniformly negative at the turn of the century but mixed thereafter, as indicated in Table 5.

Returning to the initial question, these results therefore suggest that the US was never a beneficiary of the Japanese real appreciations of the 1980s and 1990s, nor of the boom and bust cycle and eventual stagnation that followed. Assuming the US pressure on Japan in the mid to late 1980s was fully informed, the concerns of the US government could not have been motivated by average incomes. It is likely, instead, that the US motive was mercantilistic. To examine this, consider the simulated effects on Western industrial employment in manufacturing. These are shown for the end of the period in Table 6. They indicate that the loss of Japanese growth slows the demise of its more labour intensive light manufacturing industries, which are therefore still more competitive internationally, especially after the abatement of the real appreciations. Light manufacturing in Australia, the US and Europe therefore employs fewer workers as a consequence of Japanese stagnation alone.

The story differs, however, for heavy manufacturing, which from Table 1 includes chemicals, motor vehicles and electronics. The simulations suggest that the Japanese slowdown alone would have boosted employment in these industries in Australia, the US and Europe. This is due to a retarded decline in light manufacturing in Japan and the relative slowdown in its manufacturing productivity growth.²⁶ US heavy manufacturing might therefore have received some level of protection from threatened actions against Japan's apparently "undervalued" exchange rate of the 1980s. But the simulations suggest that this came at a considerable cost, mostly in Japan but also, and to a lesser extent, in the US itself and in Japan's other trading partners.

7. Conclusion

²⁶ Some aggregation bias must be noted here. The EU KLEMS estimates of Japanese productivity show comparatively strong performance continuing in its electronics sector.

Despite its key contribution to global economic growth through the 1960s and 1970s, Japan's economy has stagnated since the early 1990s. Debates have raged over the respective roles of shocks to supply (productivity and the labour force) and to demand (macroeconomic policy, financial failures) in the causation of this stagnation but there has been little published attention to the international consequences. This is due, in part, to the extraordinary growth of the Chinese economy, which has expanded to fill the residual East Asian vacuum. Yet both the reasons for the Japanese slowdown and the global consequences of it are important because the pattern of growth of emerging economies, and particularly of China, is similar to that of Japan in previous decades. China too will need to transition into economic maturity, hopefully without the boom-bust-stagnation pattern followed in Japan. A key element of this will be its accommodation by the existing advanced economies in the carriage of bilateral and multilateral negotiations over macroeconomic policy.

The results from decomposition experiments using a multi-region global dynamic model tend to confirm the supply side hypothesis, although demographic changes emerge as less important than expected. Yet the independent "catch-up exhaustion" hypothesis to explain this is questioned as suspiciously coincidental with a collapse and subsequent stagnation of investment, the links between which might be expected to emerge from further research using vintage capital models. It therefore cannot be ruled out that the origins of the productivity slowdown are in the boom and bust cycle that followed the Plaza Accord of 1985. While policy errors in Japan through the mid-1990s clearly exacerbated the negative domestic effects, eventual stagnation is shown to have resulted in a loss in global and regional economic activity that has been severe for the Japanese but relatively mild in other regions, and which has been disguised in other regions by the rise of China.

In order to fully explain the boom and bust cycle of the late 1980s and early 1990s an improved analysis would include, first, error-prone forward looking expectations, possibly following the approaches of Beaudry and Portier (2006, 2007). Second, demographic change in Japan appears to have influenced economic performance more substantially than via simple changes to the size of the labour force. A more careful consideration of the effects of ageing on entrepreneurship, worker productivity, frontier product demand and cutting edge investment are required to embed demographic behaviour more deeply into the economics. Finally, had the effects of nominal wage rigidities and the associated rise in unemployment in the later 1990s been made more explicit a greater share of the slowdown would be attributed demand side factors.

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Table 1: Product Composition

Product aggregate	Composition
Agriculture	paddy rice, wheat, other cereal grains, vegetables, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibres, other crops, bovine cattle, sheep and goats, horses, other animal products, raw milk, wool, silk-worm cocoons, forestry, fishing
Light Manufacturing	bovine cattle, sheep and goat meat products, meat products, vegetable oils and fats, dairy products, processed rice, sugar, other food products, beverages and tobacco products, textiles, wearing apparel, leather products, wood products, paper products, publishing
Heavy Manufacturing	chemical, rubber, plastic products, motor vehicles and parts, other transport equipment, electronic equipment, other machinery and equipment, other manufactures
Metals	ferrous metals, other metals, metal products
Energy	coal, oil, gas, petroleum, coal products, gas manufacture, distribution
Minerals	minerals and mineral products not elsewhere indicated
Services	electricity, water, construction, trade, water transport, air transport, other transport services, communication, insurance, other financial services, business services, recreational and other services, public admin. And defence, education, health, ownership of dwellings

Source: The *GTAP Global Database*, Version 5.

Table 2: Baseline Calibration Closure^a

Exogenous	Endogenous	Regions
Real investment	Risk premium, π	All
Saving rate ^b	Saving shifter, A^S	Japan, China, US
Real exchange rate ^c	Financial productivity, A^K	Japan, China
Real GDP	Region-wide productivity, A^R	All
Real exports	Services productivity, $A^Q(\text{services})$	Japan, China
Real exports	Financial productivity, A^K	US

a These calibration swaps represent important changes to the economies of Japan, China and the US and so behaviour in other regions is targeted only crudely.

b The saving rate used is the private rate out of disposable total (labour and capital) income.

c The real exchange rate is bilateral with the US.

Source: Chosen calibration swaps for baseline simulation only. Most exogenous variables are shocked according to recorded annual changes from IMF *International Financial Statistics*. Real exports are deflated by the respective GDP prices.

Table 3: Contributions to the Decline in Japan's Post 1990 Performance^a

	Per cent loss relative to comparator by 2007	
	Real GDP	Real per capita income
Japan's TFP, slower A^V growth	98.0	94.7
Lower birth rate	6.2	-9.7
China's TFP, faster A^V growth	5.2	1.2
Japanese home demand shocks ^b	-9.4	13.8
Total	100.0	100.0

a This compares a comparator simulation (a continuation of Japan's 1980s performance without all the stagnation shocks, and without the acceleration in Chinese productivity) with others in which one set of stagnating shocks is added to the comparator at a time.

b This is effectively a residual. It is the contribution of the collection of shocks to the risk premium, π , the saving shifter, A^S , and investment efficiency A^K , combined with calibrated short term shocks to sectoral productivity, A^R and $A^Q(\text{services})$ that proxy for other demand side effects.

Source: Simulations of the model described in the text.

Table 4: Foreign Trade Effects of Japan's Stagnation, Simulated 2007^a

		Baseline relative to comparator with full Chinese productivity growth, %
World trade volume ^b		-3.3
Total export volume	Australia	-8.2
	US	-1.7
	EU	-3.8
	Other East Asia	-6.8
	India	-19.4

a This table examines the effects of Japan's slowdown only. The baseline is compared with a comparator that includes baseline Chinese economic performance.

b This is the sum of the exports of all regions defined in the model. It is dependent on the level of disaggregation but changes in it indicate the extent of efficient global integration.

Source: Simulations of the model described in the text.

Table 5: Effects of Japan's Stagnation on Real Incomes in Western Industrial Regions^a

		Baseline relative to comparator with full Chinese productivity growth, %
Real GDP		
Australia	2000	-2.5
	2007	0.2
US	2000	-2.0
	2007	-0.4
European Union	2000	-3.3
	2007	0.3
Real income per capita		
Australia	2000	-0.4
	2007	0.2
US	2000	-2.2
	2007	-1.1
European Union	2000	-3.0
	2007	-1.1

a This table examines the effects of Japan's slowdown only. The baseline is compared with a modified comparator that includes baseline Chinese productivity growth.

Source: Simulations of the model described in the text.

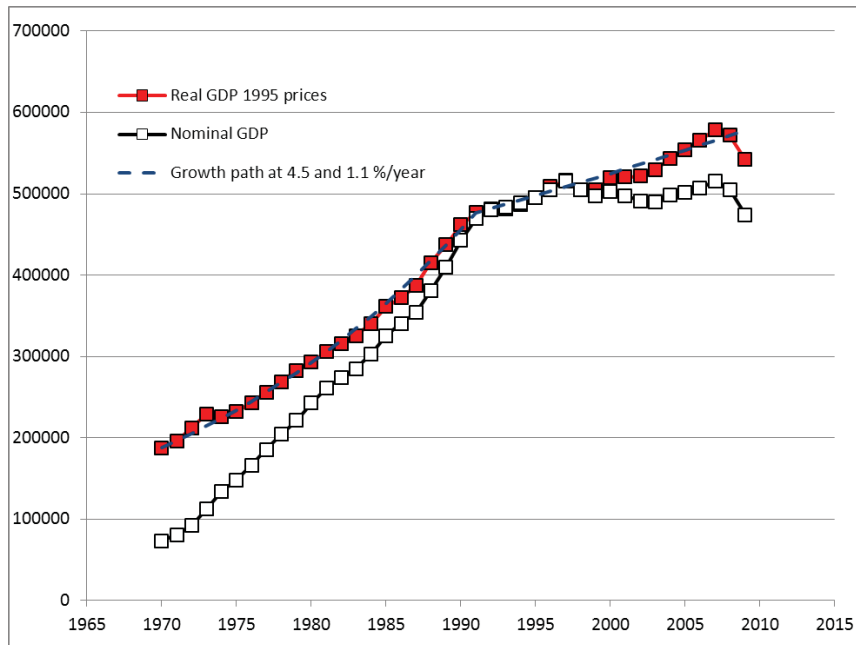
Table 6: Effects of Japan’s Stagnation on Production Worker Employment in Manufacturing in Western Industrial Regions

2007	Baseline relative to comparator with full Chinese productivity growth, %
Light manufacturing ^a	
Australia	-4.5
US	-1.3
EU	-2.6
Heavy manufacturing ^a	
Australia	3.0
US	1.8
EU	1.5

^a Light and heavy manufacturing are as defined in Table 1.

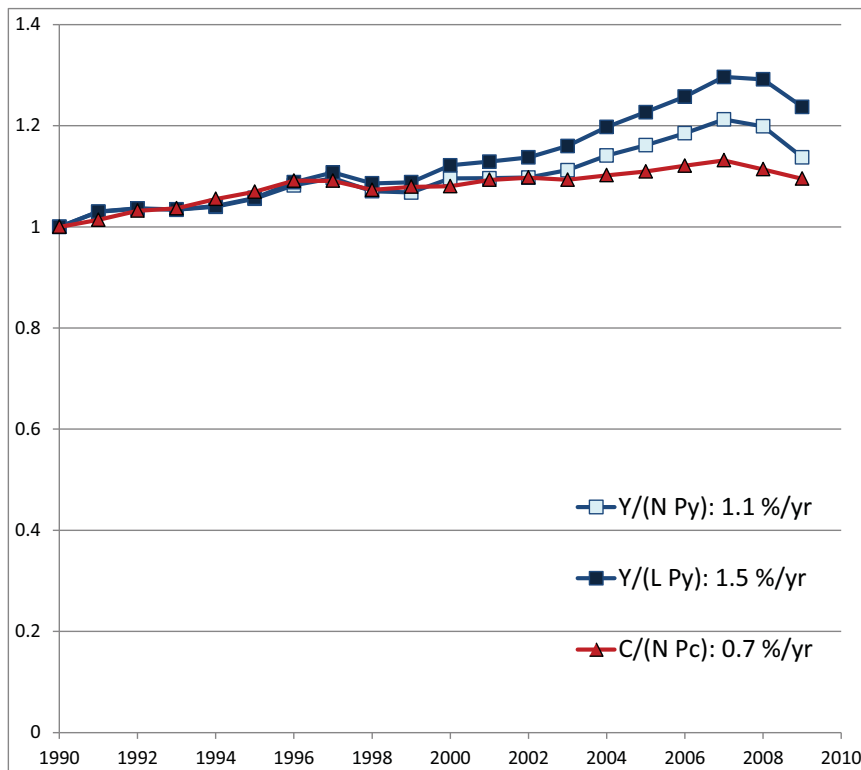
Source: Simulations of the model described in the text.

Figure 1: Japan's Nominal and Real GDP^a



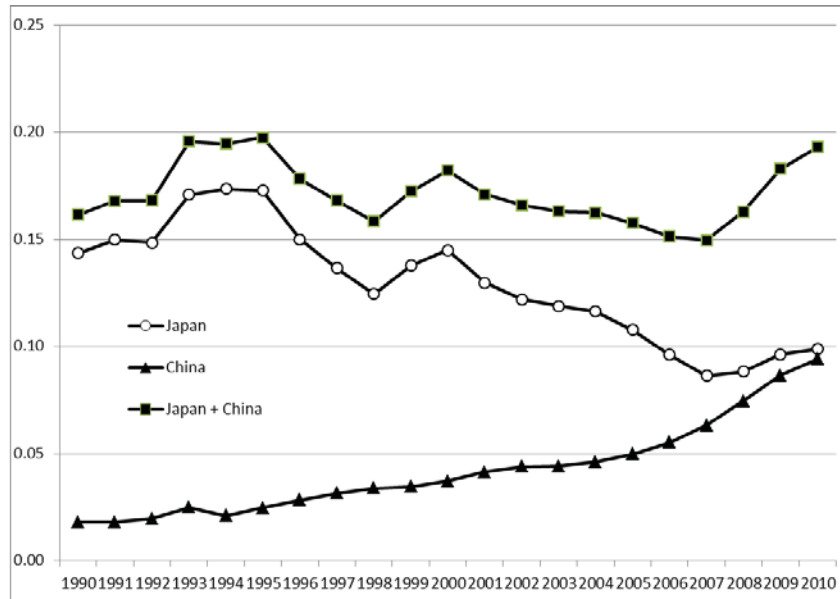
^a Here Japan's nominal GDP in Yen is deflated by its GDP deflator with 1995=1.0.
Source: IMF, *International Financial Statistics*.

Figure 2: Economic Performance Measures After 1990



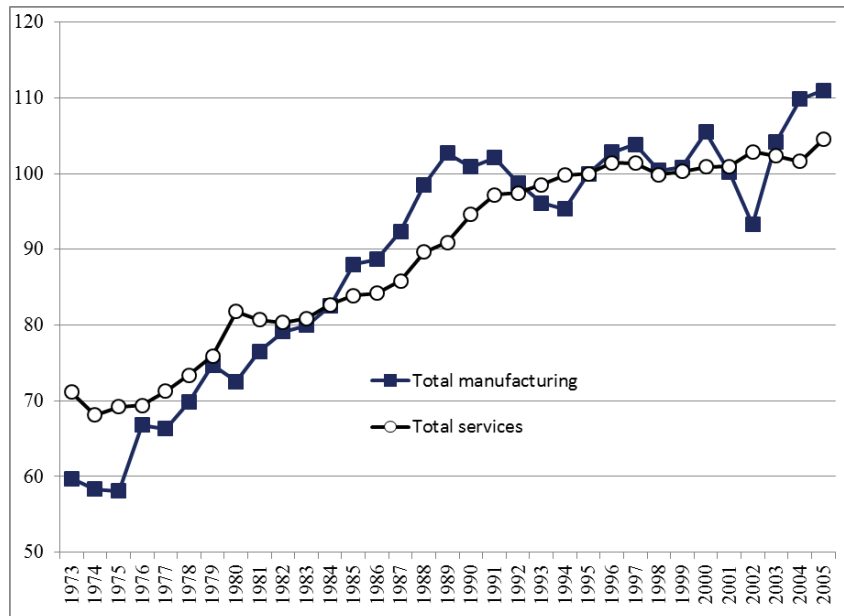
^a These are real per capita GDP, real GDP per person of working age and real consumption expenditure per capita (deflated using the CPI). Growth rates are 1990-2007. N is population, L is the number of working age (15-65), P_Y is the GDP deflator and P_C is the consumer price index.
Sources: IMF, *International Financial Statistics*.

Figure 3: Shares of Global GDP after 1990^a



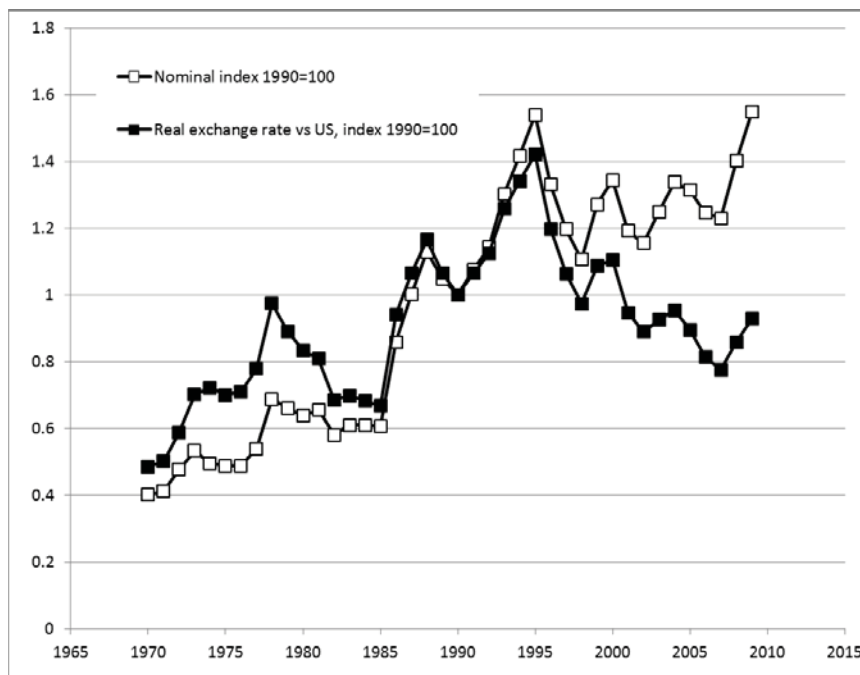
^a Although PPP adjusted data are available from this source that shift the China share substantially, this figure uses market exchange rate weights since the difference concerns primarily non-traded service prices which are irrelevant to the commercial scale of China as perceived from abroad. Source: Penn World Tables.

Figure 4: Measured Total Factor Productivity in Japan^a



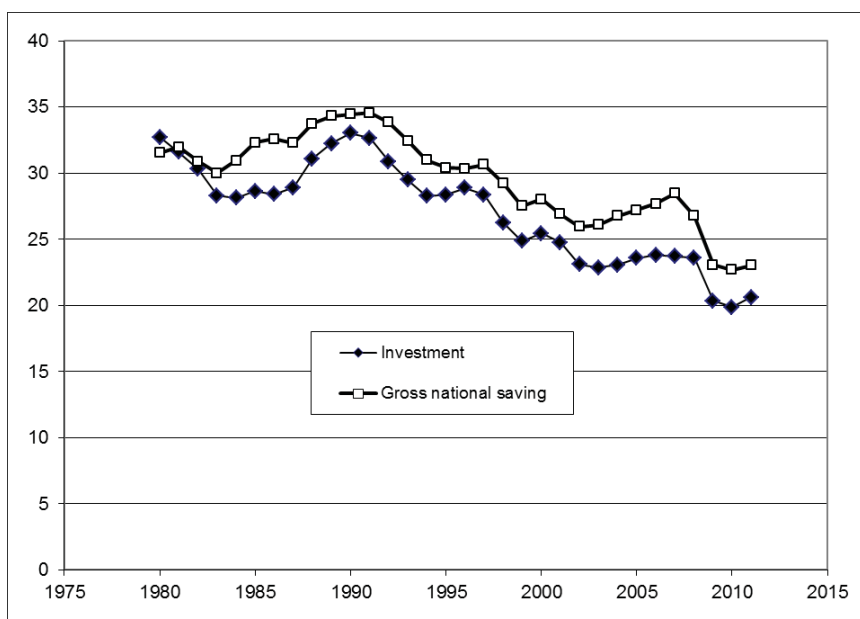
^a These are indices of Japanese total factor productivity, 1995=100. Sectoral value-added productivity figures are constructed from less aggregated industry data using Tornqvist indices with value added weights. Source: EU KLEMS database (<http://www.euklems.net/>, March 2008).

Figure 5: Japan's Real Exchange Rate against the United States^a



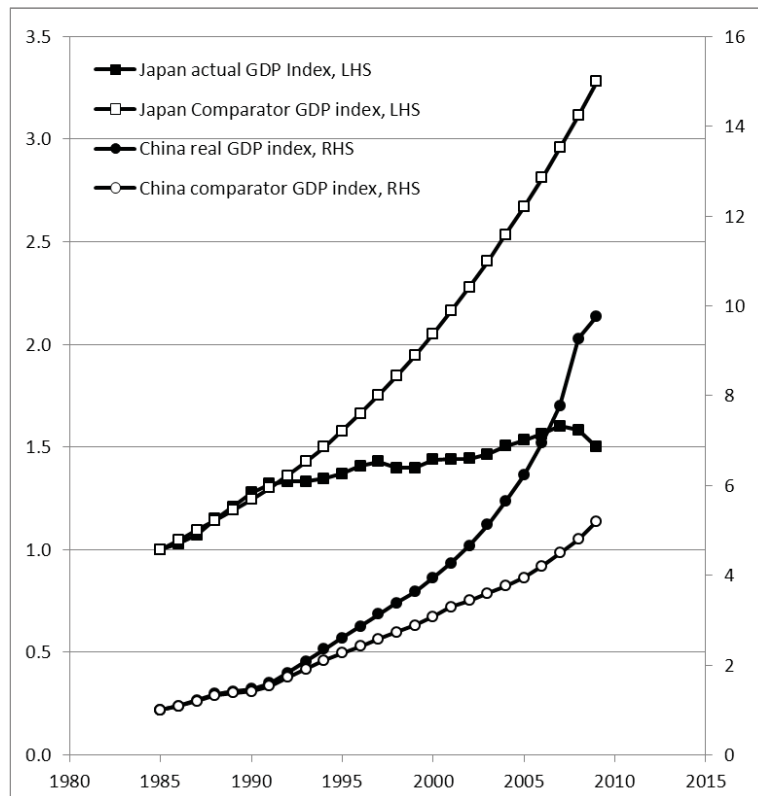
a Here the exchange rates are defined financially, so that appreciations are increases, and the real exchange rate is the nominal times the home GDP price divided by the foreign GDP price.
Sources: IMF, *International Financial Statistics*, various issues.

Figure 6: Saving and Investment in Japan^a
% of Japan's GDP.



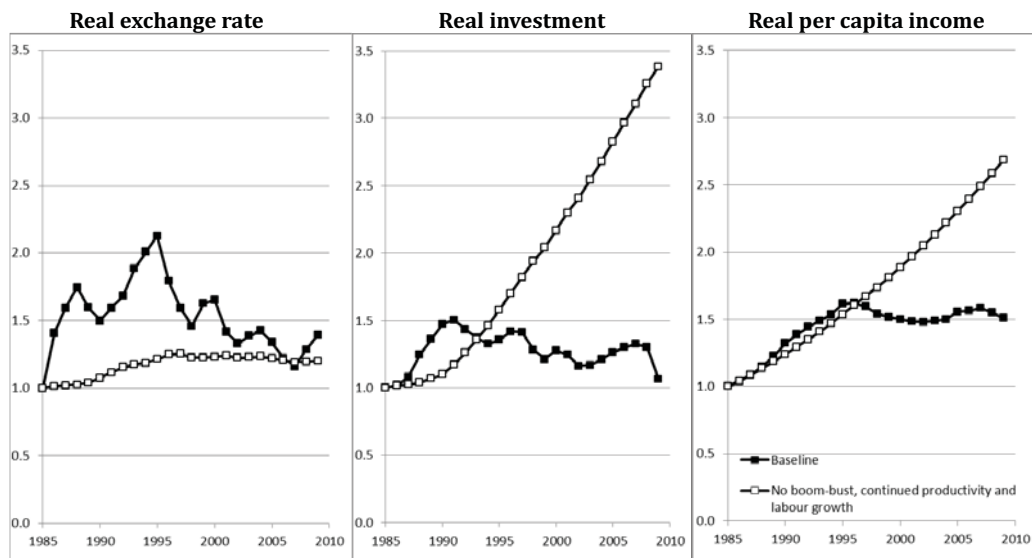
a Gross national saving covers households corporations and government and so is adjusted for fiscal deficits.
Source: IMF, *International Financial Statistics*.

Figure 7: Simulated Real GDP, Japan and China



a Indices 1985=1.0, with China's level indicated on the RH axis and set arbitrarily below that of Japan.
 Source: Simulations of the model described in the text.

Figure 8: Japan Counterfactual (No Boom Bust) and Actual 1985-^a
 (Indices 1985=1.0)

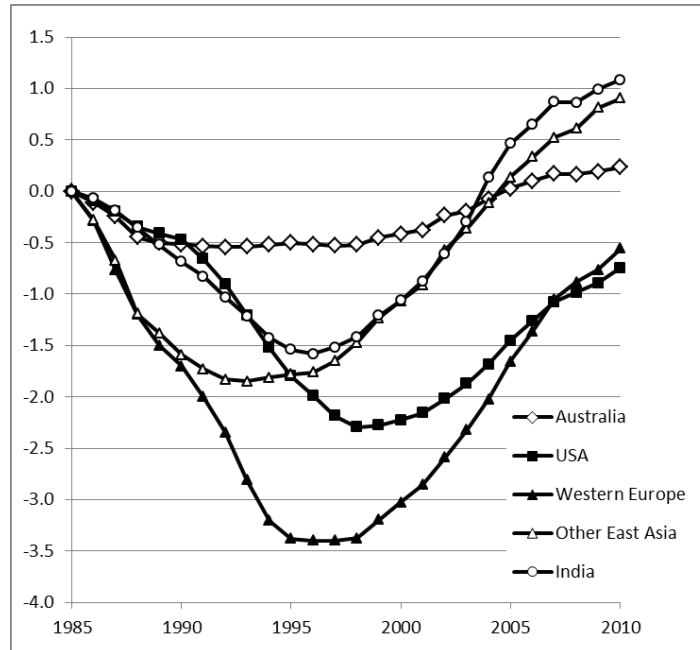


^a The simulations are the baseline, which tracks actual performance and the second comparator, which excludes boom-bust and labour shocks in Japan but includes observed Chinese productivity growth.

Sources: The counterfactual series is a simulation of the model described in the text while the actuals are derived from the IMF's International Financial Statistics.

Figure 9: International Effects of Japan's Stagnation

(% change in real per capita income)



a This compares real per capita incomes in the baseline, which tracks actual performance, with the second comparator, which excludes boom-bust and labour decline shocks in Japan but includes observed Chinese productivity growth.

Source: Cumulative per cent changes, from simulations of the model described in the text.