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Lessons from using Historical Data to build a Macro Baseline for the Dynamic GTAP Model

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1. Introduction

The development of a baseline is an important component of the experimental design when using a dynamic model such as GDyn. A baseline depicts how the economy might be expected to change, over a given period of time, without implementation of the policy under consideration. The baseline scenario should therefore reflect as closely as possible the changes expected to occur in the region of interest and in the world economy as a whole, excluding the impact of the policy being investigated. The choice of baseline can affect the results of the policy simulation (Adams and Parmenter, 2000). However, building a baseline that adequately reflects expected changes in the world economy is a difficult task.

In light of the difficulties in creating a baseline for the GDyn model, previous baselines (Walmsley, 2006) have focused on obtaining projections for a few key macroeconomic variables, such as real GDP, population, and skilled and unskilled labour; and the implementation of key policies which have already been agreed upon and are expected to affect the specific regions/sectors being considered. Another approach developed by Dixon and Rimmer (2002), which has been used in developing baselines for numerous single country models, uses a series of simulations (historical, decomposition and forecasting) to develop a baseline scenario.

In this paper, we use these techniques to develop a baseline for the Dynamic GTAP model. Our focus in this paper is on the path of the macro variables in the baseline. This focus has been chosen to reduce the enormous task of building a baseline for a global model into

manageable components; later we hope to extend the current analysis to include historical data on the evolution of sectors. The paper is divided into several sections: First, we outline the sources of the historical data collected. In the second section we outline a number of issues with the data collected which affect how we use the historical data in the baseline. In particular, there are a number of inconsistencies between the historical macro data collected and the macro balances required by the model. In the third section we move the global economy from 2001 to 2005 in a single jump, including the cumulative changes in the macro variables. The single jump allows us see the general trends in the macro variables and to obtain estimates of the average technological change, distribution parameters and changes in errors in expectations over the period. We decompose the change in real GDP to show the contribution of each of the variables in the historical simulation. In the fourth section we use these general trends to provide a year-by-year baseline from 2001 to 2020 and discuss the various assumptions of this baseline. Finally, the paper is concluded.

2. Data Sources

The GDyn aggregation used focuses on the Asian economies and has considerable regional disaggregation and limited sectoral disaggregation. Historical data on Real Gross Domestic Product (Real GDP), investment (I), consumption (C), government spending (G), saving (S), population, skilled and unskilled labor, employment of land and labor, trade balances (DTBAL), and foreign income receipts (YQHT) and payments (YQTF) were collected primarily from the World Development Indicators produced by the World Bank for all available countries. Some additional data for the Asian countries were also collected.[1]

Historical data were found to be particularly good prior to 2006. If data were not available for a country it is assumed to grow at the rate at the same rate as other regions with which it is aggregated.[2] Once aggregated into the regions of interest in the simulation, only Taiwan was

[1] We are grateful to Ginalyn Komoto and Susan Stone of ADBI for their assistance in collecting this additional data.
[2] The exception to this was the People's Republic of Korea. It is assumed to have zero growth; otherwise aggregation with the very high growing economy of Macau (and Mongolia) resulted in unrealistic growth rates which had significant and unrealistic affects on the baseline in later years.

missing data.[3] After 2005, data were not available for all countries and the aggregated growth rates were found to be unreliable or completely missing.

3. Ensuring Consistency between Historical Data and the GDyn Model

Before the historical data can be incorporated into the GDyn model consideration needs to be given to ensuring that the historical data is consistent with the macro balance constraints in the GDyn model. Four issues arise:

a) Income = Expenditure for each region

In the GDyn model the following condition holds:

Y = Real GDP + NFY = C + G + S

Data were collected on Real GDP, C, G, S and NFY (YQHT less YQTF). Only foreign income receipts are determined by the model and even these are fixed for the last region, since globally FYP = FYR. It is not possible to track all these variables. In this case we have decided to let savings be determined as the residual, since savings is also determined as the residual in the construction of the GTAP Data Base.

b) X – IM + NFY = S – I for each region

Hence, we can fix investment or the trade balance, but not both. Again we let the GTAP data base construction process guide us, which targets investment, not the trade balance.

c) Global Savings = Global Investment

Furthermore since global savings equals global investment, investment cannot be fixed for every country. One country's investment must be left free to ensure global balance: we chose Taiwan. A preliminary simulation shows that the level of global investment determined by the model is significantly different from the level of investment in the historical data on a year by year basis (Table 1), however, in aggregate the differences were minor and this did not affect our historical simulation.

[3] Therefore WDI data were augmented with data from the ADB and the China Statistical Yearbook.

Table 1: Adjustments made to Historical Investment Data

Year	Actual data was
2002	-8%
2003	+1%
2004	-22%
2005	+31%

d) Globally, Foreign income payments = Foreign income receipts

There are a number of restrictions on foreign income. First, payments must equal receipts globally. Second, foreign income is also tied to other variables in the GDyn model as shown in Table 2.

Table 2: Foreign Income in GDyn

Income earned on Capital is sent to domestic (YQHF(r)) and foreign (YQTF(r)) owners of the capital:	VOA("capital",r) = YQHF(r) + YQTF(r)
Share of income (Y) is equal to the equivalent share of wealth (W):	YQTF(r)/VOA("capital",r) = WQTF(r)/WQ_FIRM
Wealth of households (WQHHLD(r)) is equal to wealth located abroad (WQHT(r)) and at home (WQHF(r)) and is the accumulation of saving over time:	WQHHLD(r)=WQHT(r) + WQHF(r) = 100.SAVE.time
Wealth located in firms (WQ_FIRM(r)) is owned by domestic (WQHF(r)) or foreigners (WQTF(r)) and is the accumulation of investment over time:	WQ_FIRM(r) = VKB(r) = WQHF(r) + WQTF(r) = 100.NETINV.time

Hence fixing foreign income payments (YQTF) indirectly determines income payments to domestic owners (YQHF), foreign income receipts (YQHT) and the corresponding wealth variables (WQTF, WQHT and WQHF). Moreover, these variables need to remain positive in the levels and be compatible with total income earned on capital (VOA), and the savings and investment accumulation equations. In the historical simulation we choose to track foreign

income payments, rather than receipts, due to the fact that the payments data appears to be more complete (i.e., fewer missing values over the period 2001-2005). In five cases the historical foreign income payments data were found to be incompatible with the model; hence some adjustments were made for Singapore, Vietnam, Bangladesh, Pakistan and Rest of East Asia. These adjustments used shift variables to move the foreign income payments towards the change supported by the data;[4] however the entropy ultimately ensured that the model constraints were met.

4. Historical Simulation

The historical simulation is undertaken in a single period of four years in length. Since time is a variable in the GDyn model, this is achieved by shocking time by 4 in the model. Given the above constraints cumulative 4-year growth rates for 2001-2005 in Real GDP, investment (I), consumption (C), government spending (G), population, skilled and unskilled labor, employment of land and labor, and foreign income payments (YQTF) are also included in the baseline. The average yearly shocks are to these variables are shown in Table 3. The implementation of these is discussed further below.

Population (pop(REG)), skilled and unskilled labor (qfactsup(SkLab, REG) and qfactsup(UnSkLab, REG)): Each of these is exogenous in the GDyn model and hence they are simply shocked by the cumulative change over the period 2001-2005 (see Table 3).

Employment of land and labor (empl): First the normally exogenous variable empl(REG) in GDyn was revised to allow for unemployment of all endowments:

```
Variable (all, r, REG)(all,i,ENDW_COMM)
    empl(i,r) # Employment rate in region r #;
Equation EMPLOY_FACTOR # employment condition #
    (all,i,ENDW_COMM)(all,r,REG)
    qfactsup(i,r) + empl(i,r) = qo(i,r);
```

[4] Since entropy is used in the GDyn model to allocate ownership, a corresponding and opposite shift in income payments to domestic households is required in order to stop the entropy from simply negating the first shift.

empl(land) and empl(UnSkLab) were then shocked by the cumulative change over the period 2001-2005 (see Table 3).

Real GDP (qgdp(REG)): Real GDP is normally endogenous. In order to track changes in real GDP over the period 2001-2005, qgdp(REG) was exogenised and the hicks neutral technological change (afereg(REG)) was endogenised. See Table 3 for exogenous changes in real GDP and resulting endogenous changes in afereg. The technological change afereg affects the use of non-accummulable endowments (all endowments except capital) by each sector. A parameter Safereg(j,r) is added to allow for differential effects on each of the produced commodities. This allows the afereg shock to impact manufactures and services, and not agriculture following Ludena et al. (2007).[5]

```
Equation E_AFE
(all,i,ENDWNA_COMM)(all,j,PROD_COMM)(all,r,REG)
    afe(i,j,r)
      = Safereg(MAPTC2ATC(j),r) * afereg(r);
```

Estimates on agricultural production from Ludena et al. (2007) are also included. These are included as shocks to the variable aoall. Once historical sectoral data are obtained and included in the baseline, these could be used to calibrate sectoral output. For the time being however we concentrate on the macro variables and use the shares and agricultural shocks from Ludena et al. (2007).[6]

Investment (qcgds(REG)): As outlined in Walmsley (2006), historical investment can be accommodated in one of two ways: a) by introducing an additional risk premium (SDRORT(REG)) to explain the difference between actual and model determined investment; or b) by introducing an errors in expectations (srorge(REG)). The two alternatives can result in considerable differences in the long run behaviour of the model, once investment is endogenised again. In the second case, large differences in historical and model determined investment can lead to large errors in expectations which, once investment is endogenised, can

[5] These shares are available for a limited aggregation of sectors (agriculture, resources, manufactures, and services). We then use a mapping to allocate the most appropriate share to the sector (e.g., crops are allocated the agricultural shares and textiles the manufacturing share).

[6] Note that accounting for sectoral changes significantly improves the reasonableness of the endogenously determined economy-wide technological changes (afereg).

lead to large changes in investment. In the first case, any large risk premiums created as a result of tracking investment are assumed to be permanent and therefore remain; hence large changes in investment do not occur. We concentrate on the results from the second case (errors in expectations), due to the fact that initial disequilibrium in the database is assumed to be the result of errors in expectations, not risk premium. See Table 3 for exogenous changes in investment (qcgds) and resulting endogenous changes in errors in expectations (srorge).

Consumption (up(REG)) and Government spending (ug(REG)): Real per capita consumption and government spending are made exogenous by endogenising the distribution parameters. As a result the shares of consumption, government and saving in income adjust to ensure all income is spent. See Table 3 for exogenous changes in consumption (up) and government spending (ug) and resulting endogenous changes in the shares of consumption (dppriv), government (dpgov) and savings (-dpav).

Foreign income payments (yqtf(REG)): Foreign income payments are made exogenous by turning off the entropy equations which determine the allocation of income between domestic and foreign owners in the GDyn model (see Table 3).

There are a number of features in the results outline in Table 3 which should be noted:

- Technological change (afereg) appears to explain a great deal of the changes in real GDP.
- Errors in expectations are generally rising (srorge). That is, the expected rate of return is rising relative to the actual rate of return.
- Foreign ownership and foreign income payments (yqtf) increased considerably over the period 2001-2005. Foreign ownership also rose relative to domestic ownership.
- There have been changes in the distribution of income across consumption, government and saving. Savings has tended to increase globally.

Table 3: Average Annual Changes in Selected Exogenous and Endogenous Variables in the Historical Simulation

	Real GDP (qgdp)	afereg	pop	I (qcgds)	srorge	G (ug)	dpgov	C (up)	dppriv	empl (land)	empl (UnSkLab)	qfactsup (UnSkLab)	qfactsup (SkLab)	yqtf
Australia	3.41	0.56	0.85	9.73	19.69	2.56	7.03	3.12	7.67	-0.58	0.45	1.36	1.18	8.57
NZ	3.41	-0.23	0.82	8.91	14.31	2.79	31.18	4.48	33.61	0.05	0.42	1.51	1.33	5.36
Oceania	2.24	-2.58	1.20	-1.71	17.20	-1.84	15.83	-0.54	17.92	0.45	0.00	2.19	4.49	15.66
China	9.90	2.84	0.25	13.93	17.88	8.14	-4.28	7.06	-7.37	0.05	-0.16	1.23	3.69	-11.86
HongKong	5.06	2.61	0.72	0.57	3.28	-0.31	-8.89	1.16	-7.59	0.00	-0.13	0.49	5.30	3.37
Taiwan	4.62	5.72	0.40	-1.14	0.00	0.39	-11.61	2.46	-9.88	-0.46	0.12	0.54	1.09	-8.42
Japan	1.58	1.39	2.42	-0.45	23.43	-0.34	-1.31	-1.22	-2.39	-0.54	0.16	-0.16	-0.66	-6.93
Korea	4.74	4.51	0.94	3.84	9.57	3.66	-5.90	1.48	-7.89	-0.83	0.08	-0.84	4.57	-14.70
RestEAsia	3.85	1.70	2.72	5.82	27.13	-1.57	-21.16	-1.63	-21.16	0.03	0.01	1.55	2.10	2.30
Indonesia	5.00	5.16	1.02	7.69	-1.13	7.27	-1.41	3.11	-5.25	0.81	-0.60	1.18	7.11	-18.16
Malaysia	5.40	3.88	1.37	2.22	-2.14	7.49	-2.13	5.94	-4.02	0.00	-0.03	1.99	9.80	-24.53
Philippines	5.15	9.17	1.21	-0.53	4.81	-0.78	-6.00	3.77	-1.06	0.00	0.66	1.86	5.87	3.23
Singapore	5.65	3.69	0.76	-3.26	5.60	7.25	17.34	2.93	12.92	-9.64	-0.21	2.19	2.75	4.19
Thailand	5.83	10.23	2.75	10.72	2.41	2.67	-3.14	2.78	-3.52	-1.94	0.33	0.52	5.31	-9.32
Vietnam	7.66	4.47	1.18	11.37	27.29	5.88	-26.26	6.26	-25.69	0.29	0.13	2.40	2.96	34.73
RestSEAsia	5.31	2.95	1.75	7.82	6.00	-1.02	5.04	6.12	12.36	1.27	0.05	1.45	4.35	23.21
Bangladesh	5.47	-0.37	3.20	8.89	14.69	9.14	5.88	0.65	-2.24	-0.20	0.00	2.81	5.72	55.28
India	7.39	8.15	1.35	13.94	10.27	1.18	-11.86	4.16	-8.75	-0.02	-2.38	1.83	5.44	5.96
Pakistan	5.76	6.80	1.82	1.93	3.08	4.29	62.22	3.99	63.46	-5.46	0.03	3.28	5.19	11.90
RestSAsia	4.85	-1.29	1.33	9.01	13.75	11.38	28.62	4.13	19.93	0.01	1.30	1.81	5.59	19.27
US	2.82	1.16	4.63	2.76	19.17	-1.83	10.41	-1.36	10.74	-0.01	-0.11	1.21	1.22	7.44
RestNAmerica	2.54	-1.44	1.43	4.81	14.03	-0.42	-6.28	0.64	-5.09	-0.01	-0.23	2.02	2.64	-0.41
LatinAmer	3.44	-0.79	0.76	2.95	11.82	2.02	-6.27	1.87	-6.13	0.13	1.74	1.47	5.71	3.84
EU_27	1.69	0.43	1.83	1.84	15.60	0.14	3.39	-0.14	3.03	-0.57	-0.11	0.17	0.31	1.99
RestEurope	1.93	0.20	1.40	4.07	21.47	0.65	3.23	3.27	5.88	-1.02	0.37	0.74	0.96	2.87
Russia	6.40	10.35	1.71	9.57	15.35	0.26	-4.58	7.81	1.47	-0.14	0.16	0.05	0.60	1.92
FSU	8.29	4.77	1.09	15.66	7.31	1.34	21.96	10.26	32.19	0.05	0.31	0.88	1.43	19.55
MENA	5.51	5.05	1.25	9.07	6.35	1.16	-7.51	4.66	-4.07	-1.36	0.37	2.38	4.86	7.10
SSA	4.85	6.00	1.11	5.27	9.83	4.34	-5.59	3.12	-6.57	0.38	0.08	2.42	3.05	5.39

5. Decomposing Historical Real GDP

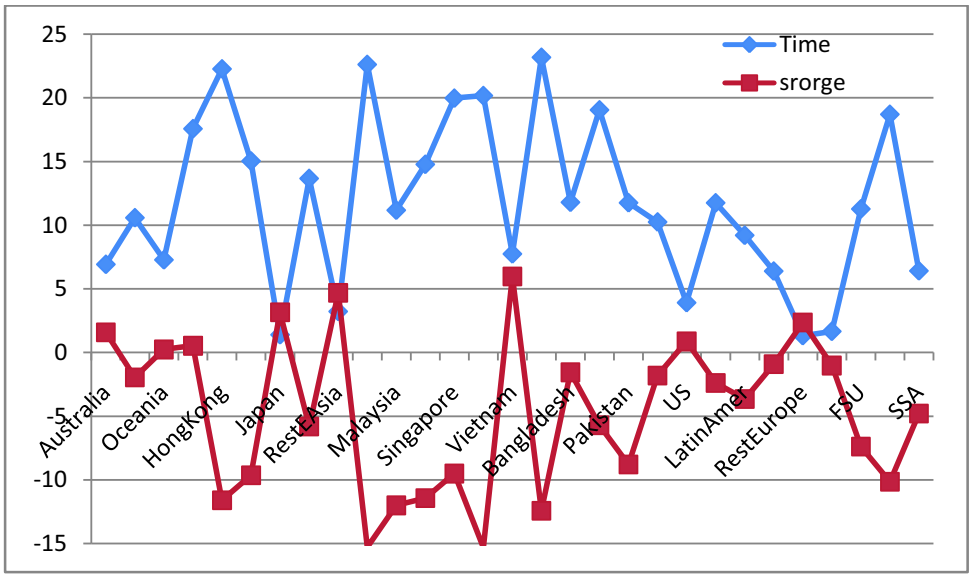
In this section we decompose the changes in real GDP according to each component of the four year historical simulation to ascertain their importance. Table 4 shows the proportional contribution to the change in real GDP contributed by each element of the baseline, with the final column indicating the total change in real GDP for each region, over the four year period.

Table 4: Decomposition of Historical Real GDP: Components of the Baseline (% contribution)

	Time	Unskilb	Sklab	pop	empl	aoall	yqtf	up	ug	sroge	afereg	Increase in GDP
Australia	48.2	14.4	8.7	0.2	5.0	2.4	0.0	0.2	-3.1	11.0	13.1	14.4
NZ	73.7	17.2	7.3	0.2	5.3	4.6	0.0	2.6	-3.5	-13.7	6.4	14.3
Oceania	78.3	37.0	42.1	0.6	0.4	5.9	0.1	-4.0	-23.9	2.5	-39.0	9.3
China	38.3	5.6	4.0	0.0	-0.8	31.2	0.0	-0.7	-1.5	1.1	22.7	45.9
HongKong	101.9	2.4	25.5	-0.1	-0.9	0.8	0.0	-1.6	-5.9	-53.1	31.1	21.8
Taiwan	75.9	4.0	6.4	0.0	0.9	1.3	0.1	-1.7	-4.5	-48.7	66.4	19.8
Japan	21.4	-6.1	-11.9	1.0	4.0	3.5	0.0	-1.5	-8.7	48.7	49.5	6.5
Korea	67.1	-8.3	16.2	0.1	0.4	3.5	0.0	-2.5	-5.1	-28.6	57.2	20.3
RestEAsia	19.7	17.5	7.5	-0.2	0.1	6.3	0.1	-0.7	-2.9	28.7	23.9	16.3
Indonesia	104.9	6.6	12.5	-0.2	-2.9	10.2	0.0	-2.9	-5.1	-70.9	47.8	21.6
Malaysia	47.6	15.4	24.4	0.0	-0.3	4.3	0.1	-1.2	-3.4	-51.3	64.3	23.4
Philippines	66.3	9.0	12.2	-0.1	3.6	13.1	0.0	-1.1	-4.7	-51.4	53.1	22.3
Singapore	81.1	13.0	10.4	-0.1	-1.8	1.8	-2.5	0.4	-2.3	-38.7	38.7	24.6
Thailand	79.3	1.5	8.9	-0.1	-0.4	7.1	0.0	-1.1	-4.8	-60.3	70.0	25.4
Vietnam	22.5	12.5	4.9	0.1	0.9	6.4	0.1	2.9	3.1	17.3	29.1	34.4
RestSEAsia	100.7	8.6	10.6	-0.2	2.0	6.7	0.0	1.0	-7.0	-54.1	31.8	23.0
Bangladesh	49.6	23.0	13.5	0.1	-0.4	23.9	0.0	-1.7	-3.0	-6.6	1.6	23.8
India	57.7	9.6	8.8	-0.6	-14.3	16.0	0.0	-0.2	-3.5	-17.3	43.9	33.0
Pakistan	46.8	22.6	13.9	0.0	-11.8	26.3	0.0	0.0	-1.9	-35.1	39.4	25.1
RestSAsia	49.1	16.6	15.8	0.1	12.9	21.9	0.0	-0.2	-2.6	-8.7	-4.7	20.9
US	33.2	18.2	13.9	0.5	-1.7	1.5	0.0	1.0	-0.8	7.3	26.8	11.8
RestNAmerica	111.1	28.8	16.1	-0.2	-3.7	8.6	0.0	-4.9	-17.7	-22.7	-15.2	10.6
LatinAmer	63.4	16.9	34.2	0.2	23.0	4.8	0.0	-5.6	-9.7	-25.3	-2.0	14.5
EU_27	91.9	1.9	3.1	0.0	-3.0	5.3	0.0	-2.5	-10.3	-13.3	26.9	6.9
RestEurope	16.5	14.1	12.7	0.3	7.2	9.4	0.0	5.4	-7.3	29.5	12.2	8.0
Russia	5.9	-0.5	0.5	0.1	0.9	5.0	0.0	0.8	0.6	-3.6	90.4	28.2
FSU	30.0	3.4	0.6	-0.1	1.6	50.3	0.0	1.5	0.9	-19.7	31.6	37.5
MENA	78.1	13.1	11.8	-0.1	1.9	-0.6	0.0	-1.0	-6.2	-42.5	45.4	23.9
SSA	30.7	20.9	9.0	0.0	0.8	2.7	0.0	-0.4	-1.7	-23.0	60.9	20.9

The shock to time contributes a significant proportion of the change in real GDP for many regions, however, this time component appears inversely correlated with errors in expectations (srorge), as shown in Figure 1. Despite this, for more than two thirds of the countries in our aggregation, the combined impact of time and srorge remains the largest contributor to changes in historical real GDP. Turning to changes in investment (qgds) in the historical simulation, Table 5 shows that changes in investment driven by time in the model are higher than the overall historical investment changes for most regions. Changes in srorge tend to offset investment effects due to time and for many regions, the impact of srorge on changes in investment is negative. This is mirrored by the impact of srorge on real GDP being negative for these regions (Table 4).

Figure 1: Contribution of Time and Errors in Expectations (srorge) to Changes in Real GDP (%)



As noted above, technological change (afereg) also appears to explain much of the change in real GDP (Table 4). Other components generally contribute less significantly to real GDP in the historical simulation, though labour supply and agricultural productivity (aoall) changes are significant contributors to real GDP for some regions.

Table 5: Selected Components and Total Change in Historical Investment (qcgds) (%)

	Time	srorge	Total change in investment
Australia	12.5	19.6	43.1
NZ	56.7	-20.7	39.5
Oceania	2.4	1.8	-5.8
China	31.6	6.6	67.7
HongKong	102.8	-100.6	2.5
Taiwan	101.2	-117.3	-1.0
Japan	-47.3	40.1	-1.7
Korea	63.9	-55.3	15.6
RestEAsia	-52.3	56.9	24.4
Indonesia	208.3	-177.6	33.4
Malaysia	178.1	-206.9	10.1
Philippines	107.8	-108.3	0.3
Singapore	53.4	-71.4	-10.7
Thailand	203.9	-174.4	49.2
Vietnam	-37.3	49.5	52.2
RestSEAsia	135.1	-110.2	31.1
Bangladesh	44.4	-14.7	40.3
India	102.6	-54.3	68.0
Pakistan	94.5	-112.1	10.4
RestSAsia	43.1	-20.3	38.3
US	-16.0	13.7	11.6
RestNAmerica	52.4	-20.6	20.7
LatinAmer	51.4	-39.5	12.2
EU_27	24.0	-9.7	7.7
RestEurope	-26.3	32.9	17.6
Russia	-32.9	-8.1	43.6
FSU	65.2	-79.2	76.4
MENA	119.9	-91.0	37.7
SSA	38.7	-55.8	25.1

6. The Baseline

The baseline we are developing moves the economy from 2001 to 2020. Over the period 2001-2005, the average trends found in the historical simulation are imposed on the baseline. After 2005, we must decide which of these average patterns over the period 2001-2005 are likely to continue into the future, i.e., 2006-2020. This is an iterative process since some of the

trends between 2001 and 2005 are unlikely to continue, for example the saving rates and changes in employment cannot continue to increase indefinitely. We examine the results of two alternative baselines in this section:

1. *All Trends continued*: All trends are continued from 2006 to 2020, except those which cause inconsistencies in the balancing constraints. Those trends that are inconsistent with the various balancing constraints include the upward trend in foreign income payments of Bangladesh, Vietnam, Singapore, Vietnam and Rest of East Asia, and are therefore not continued into the future.
2. *Some Trends Discontinued*: Certain trends, the share of consumption and government in income, investment/errors in expectations and foreign income payments, are gradually discontinued from 2006 onwards.

The results of these are discussed in turn below.

All Trends Continued

This baseline scenario demonstrates a continuation of the status quo. Real GDP growth rates continue at current levels for the USA and Europe; China's growth rate declines, while India and Thailand experience increased growth rates that eventually decline (Figure 2). Investment in the EU and USA continue to grow as errors in expectations continue to be held (Figure 3). Growth in investment in China, India and East Asia initially increases, but eventually declines as capital stocks accumulate. Trade balances continue their current paths (Figure 4), with trade surpluses in China and India rising with increases in capital outflows and trade deficits in Europe increasing with net capital inflows. Trade balances do start to turn after 2015 with the increase income flows offsetting the slight slowdown in investment. Changes in the terms of trade (Figure 5) reflect changes in capital flows and the trade balance.

Figure 2: Selected Annual Growth Rates in Real GDP (%) over Time

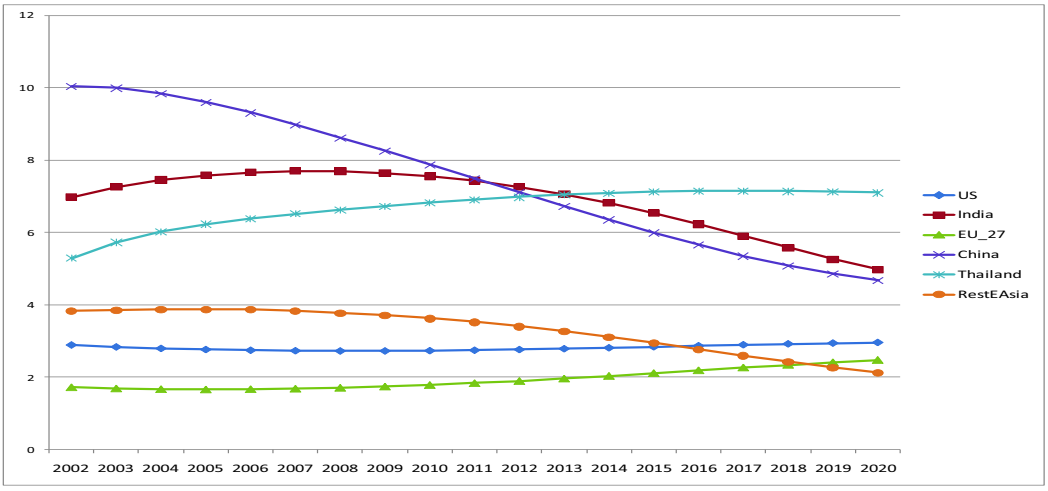


Figure 3: Selected Cumulative Growth Rates of Investment (%) over Time

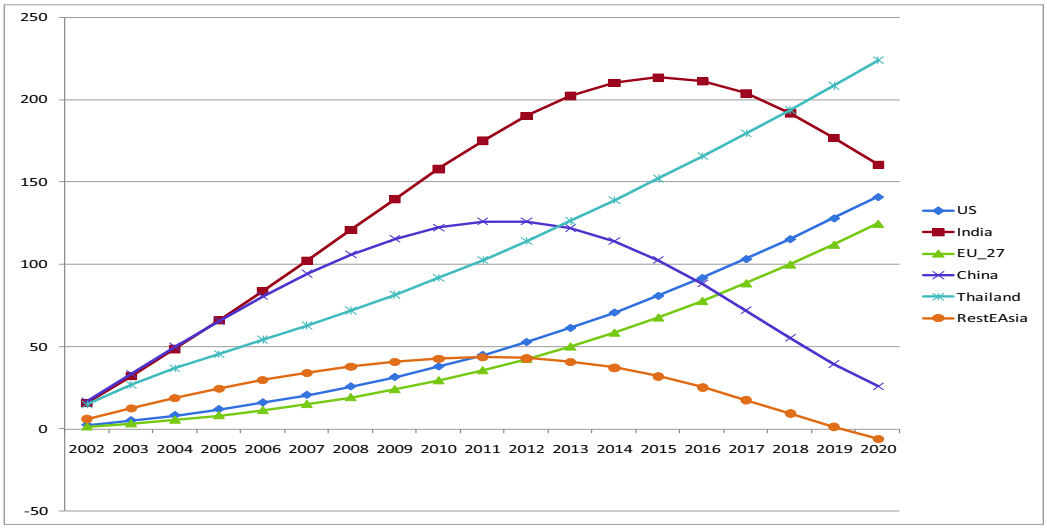


Figure 4: Selected Yearly Changes in the Trade Balance ($US Millions) over Time

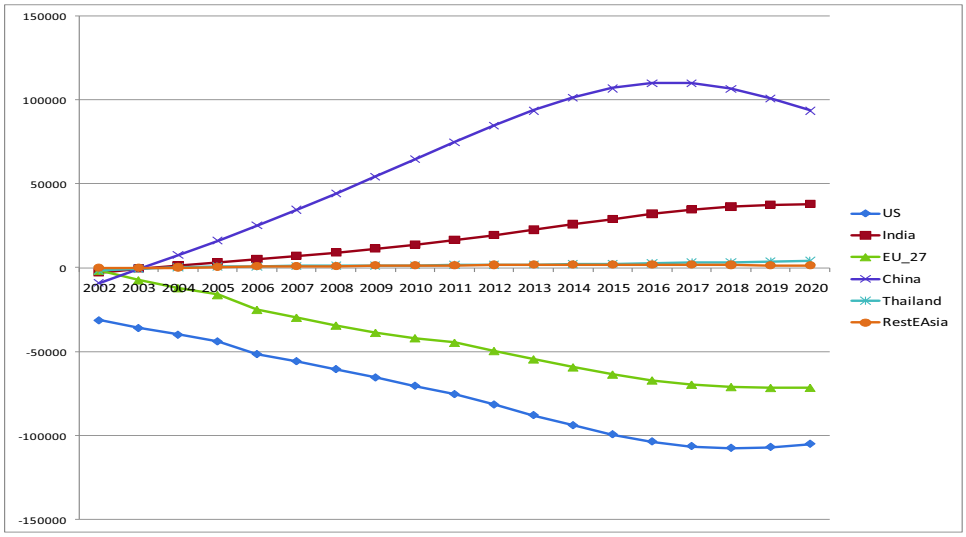
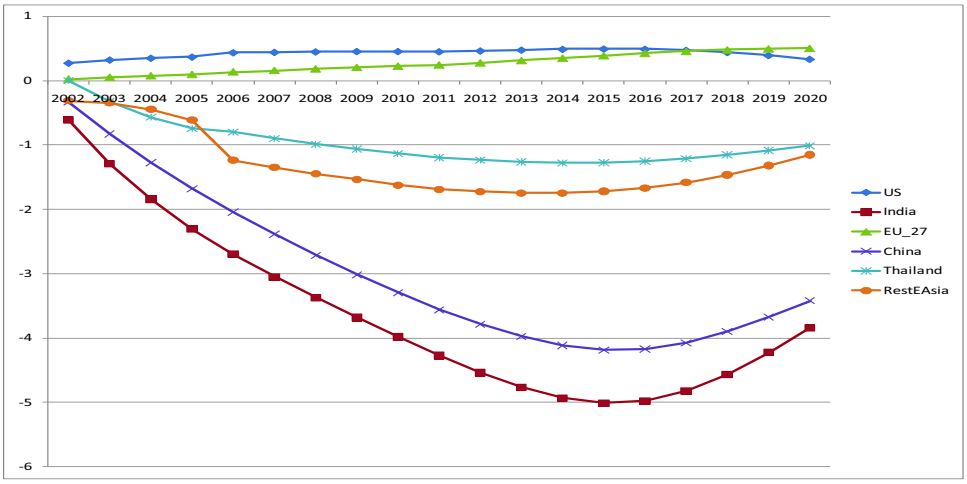


Figure 5: Selected Yearly Growth Rates in Terms of Trade (%) over Time



Some Trends Discontinued

In this scenario some of the trends found in the historical data (2001-2005) are not continued; these include the continuation of errors in expectations, changes in the distribution of income and the continued growth of foreign ownership. The decisions related to these are discussed in greater detail below.

In the standard GDyn model and Data Base, errors in expectations exist in the initial database (i.e., the initial database is in disequilibrium) and are gradually removed over time as a

result of the investment allocation mechanisms in the model. When investment is set exogenously and errors endogenously, as in the historical simulation, errors adjust so that investment determined by the model matches the exogenously imposed investment. In the historical simulation this resulted in an increase in errors in expectations over the period 2001-2005. In building the baseline, we must decide whether or not these higher errors in expectations continue to be held, and if not, at what rate they should be eliminated. In the scenario above, the errors in expectations were assumed to continue, in this scenario we consider the case where these errors in expectations are removed.

The justification for removing the errors in expectations comes from the yearly historical data and the recent financial crisis.[7] Yearly historical data reveals that errors increased until 2004 and then, for the most part, declined in 2005 (Figure 6). In this case it is assumed that this decline in 2005 is the start of a general decline in errors in expectations and hence we assume this decline continues. Figure 7 shows how errors in expectations on US investments are eliminated over time by the model. In 2006 and 2007, the elimination of errors is managed; the exogenously applied trend in errors, that were seen in 2001-2005, is halved in 2006 and eliminated in 2007. After 2007, the model gradually eliminates any errors in the initial data base. For the US, errors in expectations continue to fall until approximately 2018.

Since the increase in foreign ownership is likely to be related to this increase in investment, the upward trend in foreign ownership is also discontinued with the errors in expectations. Furthermore, changes in the distribution of income across consumption, government and saving are also assumed not to continue, since yearly changes show considerable variation over time and savings rates cannot continue to increase without limit.

[7] It should be noted, however, that this simulation does not claim to be an analysis of the impact of the financial crisis. Our aim here is to examine alternative baseline assumptions.

Figure 6: Errors in Expectations Resulting from Targeting Investment (year on year)

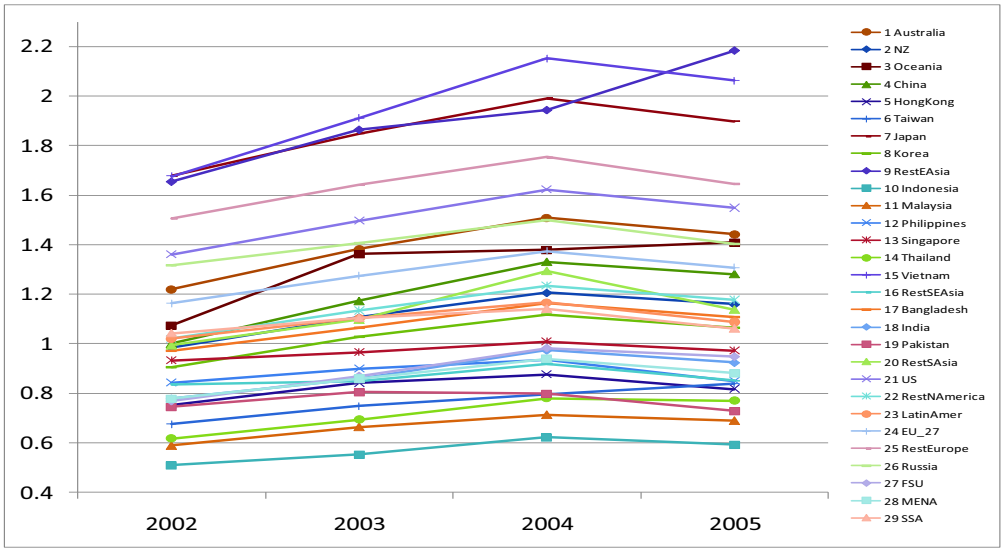
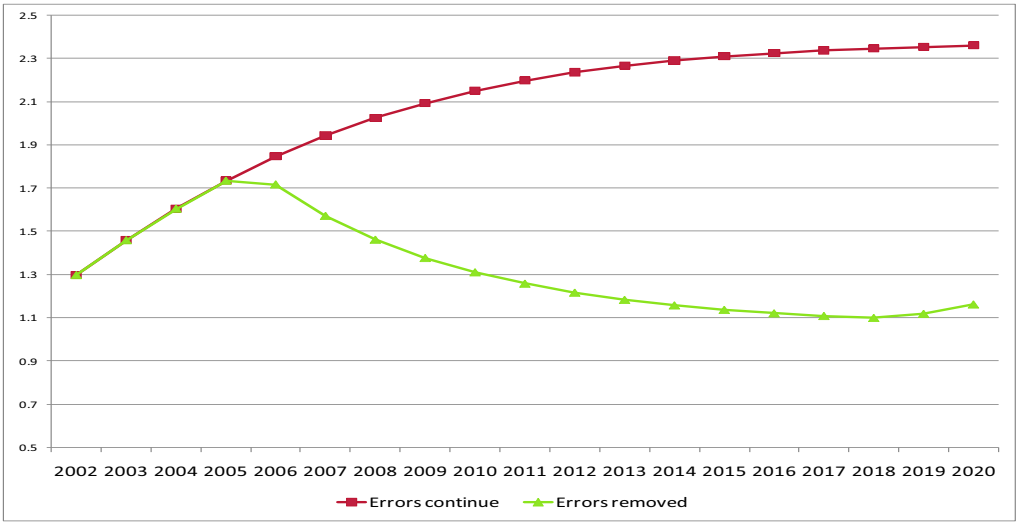


Figure 7: Errors in Expectations in the USA over Time under the Alternative Assumptions



The removal of these trends in errors in expectations has a considerable impact on investment (Figure 8). Investment in the US, Japan, Australia and the Rest of East Asia falls considerably close to zero by 2020; investment in India, South East Asia and China rises initially as global savings finds its way to investment in alternative countries, but eventually the global decline also leads to a decline in investment in these countries. Growth rates in real GDP fall as the lack of investment leads to declines in capital stocks (Figure 9). The implications of the

removal of these errors in expectations are severe and long-lasting; however it is not clear that all of the disequilibrium in investment is the result of errors in expectations, or if some of it could be the result of differential risk premiums.

Figure 8: Selected Cumulative Growth Rates of Investment (%) over Time

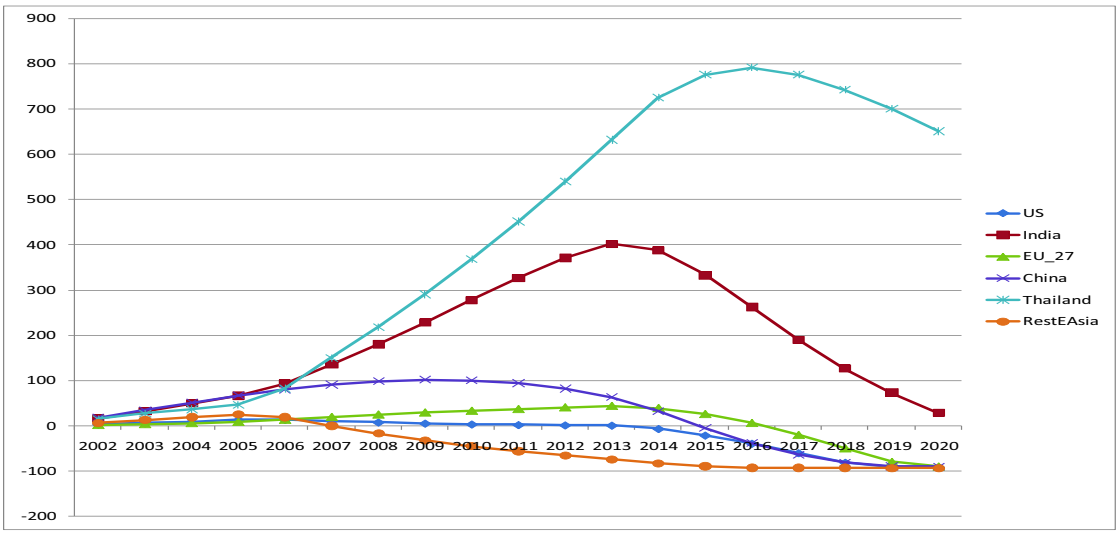
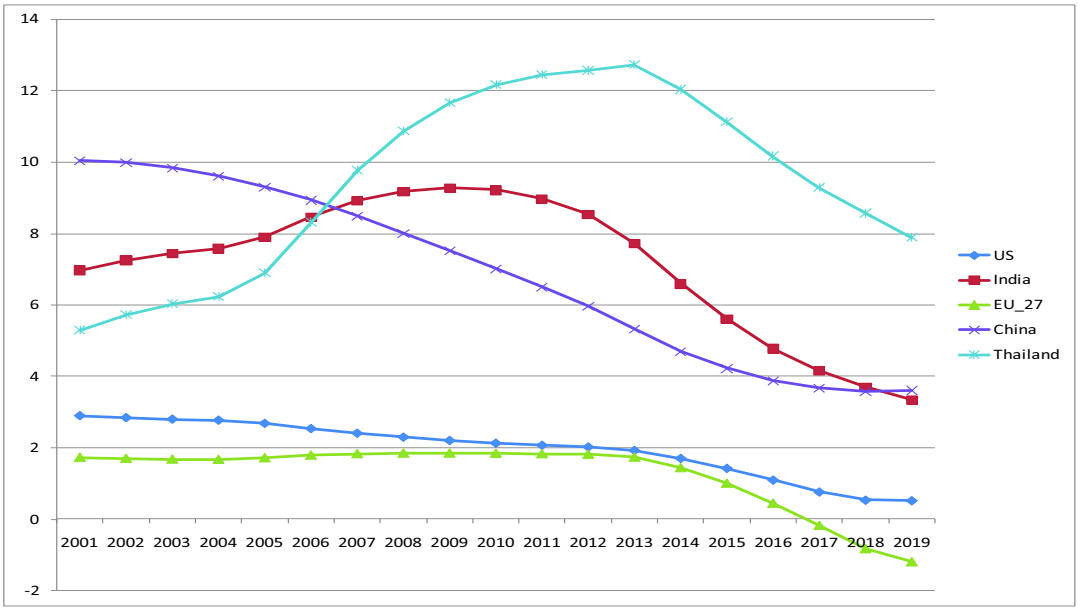


Figure 9: Selected Annual Growth Rates in Real GDP (%) over Time



7. Conclusions and Future Research

The purpose of this paper was to examine how historical macro data could be used to help develop a baseline for the GDyn model. We found that while there were some issues related to global and model consistency when using historical data, the use of historical data allowed us to incorporate certain trends that the model would not have otherwise had if only time were shocked, thereby yielding a more realistic baseline.

This is just the beginning of a fully developed baseline; further investigation is needed to compare the use of risk premiums with errors in expectations in tracking and determining investment. Moreover once sufficient data are obtained, historical trends in sectoral output and trade can be incorporated so as to further improve the baseline.

8. References

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